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China Near Seas Combat Capabilities

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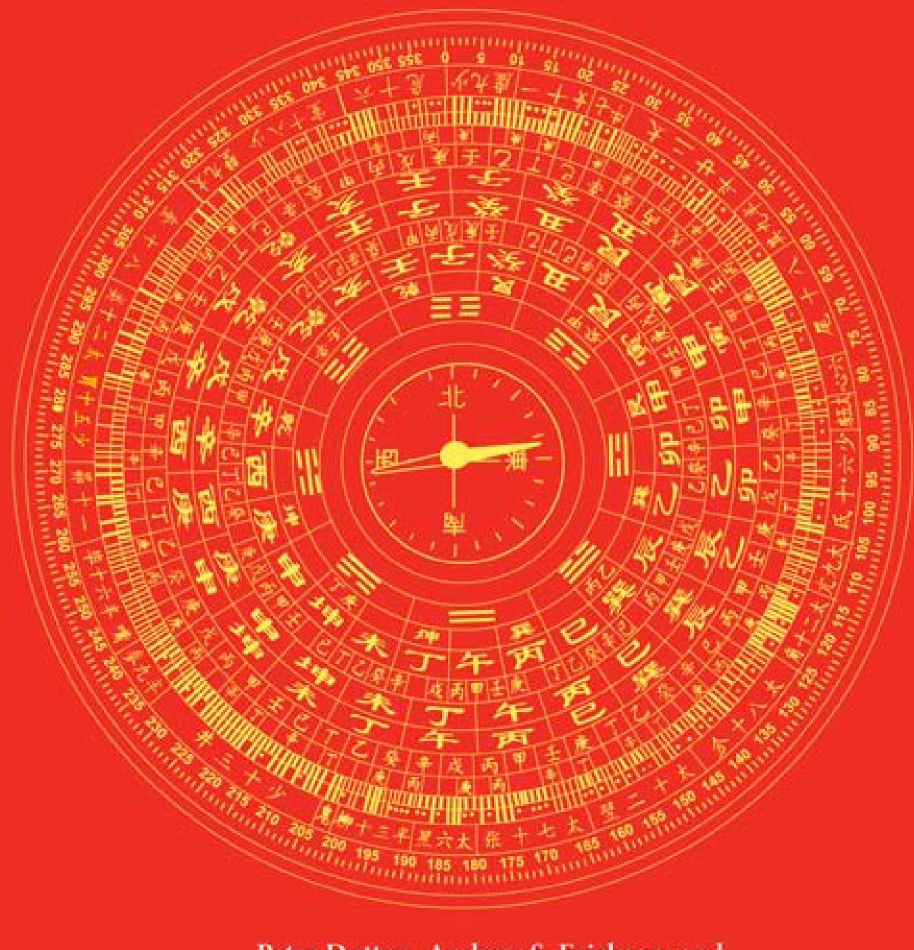

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Beyond Sea Denial

John Patch

The capstone U.S. Defense Department study on the future operational environment declares, "China's rise represents the most significant single event on the international horizon since the collapse of the Cold War."[1] Understanding and assessing changes in China's traditionally defensive naval strategy, doctrine, and force structure are of obvious importance to the U.S. Navy (USN) and other Pacific navies concerned with the possible security implications of that rise. This chapter examines the development of the Chinese navy's Houbei (Type 022) fast-attack-craft force and its roles and missions in China's near seas and discusses implications for the U.S. Navy and other navies in the region. The author argues that this force, when integrated with People's Liberation Army Navy (PLAN) units and task groups in joint operations, provides an offensive sea-control capability beyond simple coastal defense (coastal defense here being a limited form of sea denial). Indeed, linked fast attack craft operating collectively may present a significant potential offensive threat to American capital ships and strike groups well beyond the littorals.[2]

Origins of the Houbei Fast Attack Craft

PLAN doctrine outlined the purpose of the fast-attack-craft force as early as 1950. Beijing sought a modern, lightly armed offshore coastal-defense element to place alongside the key PLAN forces, naval aviation and submarines.[3] These fast-attack-craft units consisted of relatively fast (thirty-plus knots), single-mission hulls, including subchasers and torpedo boats (later, guided-missile boats) that operated in speedboat *zhidui* ("flotillas").[4] Early fast attack craft were adequate to the coastal-defense missions of countering Nationalist Chinese "invasions" and later, Soviet and American amphibious threats over home waters;[5] they were available in large numbers and could be rapidly deployed along interior lines. They were, however, very limited in endurance and range.[6] Nonetheless, because PLAN resource limitations precluded the development of large combatants before the 1980s, the occasional maritime clashes that did occur involved fast attack craft—including the sinking of several adversary fast attack craft and small combatants.

In the 1980s the PLAN commander, Adm. Liu Huaqing, played an important role in changing the service's mission (and mind-set) from coastal defense to offshore defense—or "near-seas active defense"—with a commensurate change in fast-attack-craft roles and missions. Naturally, this doctrinal shift called for a different force to cover a much larger area, a force relying less on fast attack craft for coastal defense and requiring more offshore-patrol vessels for longer-duration patrols in the three near seas. Fast attack craft still had a significant support role for amphibious operations against Taiwan, but other near-seas missions, like protection of sea lines of communication and patrol of the exclusive economic zone (EEZ), demanded a new force of multimission vessels with improved blue-water seakeeping and endurance. During this period, accordingly, PLAN fast attack craft, numbering some two hundred by 1990, obsolesced as demand decreased.[7] As the PLAN cast its gaze beyond the EEZ, however, the need for a modern, offensive fast attack craft became apparent. Offshore-patrol vessels persisted, and in greater numbers than fast attack craft (they continue their missions to the present), but they could not serve as fast attack craft in the modern sense. The Houbei class answered that requirement.

Sources on PLAN requirements for a new fast attack craft are either unavailable or protected, but it seems clear from early acquisition activity that the need for a modern fast attack craft had become pressing by around 1998. For example, China sought to acquire Molniya-class fast attack craft from Russia in the early 2000s, though the sale never reached fruition.[8] Houbei hulls began appearing in 2004.

The Houbei represented a marked change from previous-generation fast attack craft and offshore-patrol vessels. It is not just a replacement for the Chinese versions of the Osa and Komar coastal-defense fast attack craft; it represents a capability shift decidedly in the offensive direction, a shift relevant to the "active defense" aspect of near-seas operations. ONI analysts emphasize Houbei's "better sea keeping, speed, and mission flexibility" in comparison to the older missile boats.[9] It is certainly not simply an offshore-patrol vessel replacement, as the Type 037 variants are still relatively capable and thus not in dire need of replacement; in any case, the Houbeis do not have the offshore-patrol vessels' long range or endurance.

While still viable for other missions, the older Houjian, Houxin, Haiqing, and Haijiu classes cannot serve as modern fast attack craft: they are too slow, most are not data-link capable, and none have long-range antiship missiles. The PLAN designed the recently revealed Type 056 corvette to replace the Houjian—with an escort and air-defense mission for the farther reaches of the near seas—a development supporting the assertion that the Houbei is not a follow-on offshore-patrol type.[10] For now, the more than sixty "combat operational" Houbeis constitute the sole modern PLAN fast-attack-craft class.[11]

Houbei within a Changing Naval Strategy

There is no question that the PLAN is evolving to meet expanding regional missions and that the Houbei class will play an important role. What is less clear is how China is evolving its strategy, doctrine, and operational concepts to meet new near- and far-seas requirements.[12] The PLAN is transforming its force structure to make it more appropriate for offensive operations beyond the traditional littoral tether. Gaps persist in the body of literature with respect to this transformation, but it is possible to assess the part that fast attack craft play. Similarly, since the recurring Chinese white papers do not move much beyond generalities, open-source material and PLAN operations and exercises provide important evidence on key developments. Finally, the near- and far-seas concepts are not really formal "strategies" in the Western sense—indeed, there does not appear to be any Chinese naval or maritime strategy comparable to U.S. versions.[13] Still, it is instructive to use near/far-seas concepts in a strategic sense.

It is important to note that with an expectation of increasing far-seas missions for larger PLAN combatants, fast attack craft will, logically, need to be relevant well outside coastal waters. The far-seas concept endorsed since the mid-2000s, for instance, clearly requires a PLAN that will operate with increasing reach and with offensive capabilities.[14] The Center for Naval Analyses assesses that Beijing's intent to extend its strategic depth for active defense is an "expansion of the armed forces' geographic and functional security interests."[15] PLAN development trends in support of far-seas missions include long-range standoff weapons and extended overseas deployments—including the requisite sustainment, such as at-sea logistics and overseas bases.[16] As PLAN major combatants move out of the near seas, then, smaller combatants like the Houbei can be expected to fill the gap in the near seas.

The Houbei missions fit within the recent PLAN emphasis on expanding near-seas missions beyond sea denial (which, of course, is inherently defensive) to sea control. The PLAN has naturally focused on sea control for a Taiwan contingency, but recent exercises and deployments involving fast attack craft seem to demonstrate a shift to sea-control missions in the larger near-seas region. Indeed, RAND assessed in 2009 that PLAN modernization is "specifically designed to allow the PLAN to move over this period from sea denial to sea control capabilities in a regional conflict."[17] Many respected China watchers have reached similar conclusions, describing these developments as distinctly offensive in nature.[18]

Houbei's Potential for Offensive Roles and Missions

If the fast attack craft is to be relevant to sea control missions, it must have inherently offensive capabilities—and it does.

At first blush, the craft may seem to have only defensive weapons, but it is the Houbei's collective offensive punch that has the most potential for sea control, as opposed to denial. Houbei fits into "green-water active defense," but some forget that this role involves offensive missions in certain circumstances.[19] The PLAN clearly designed the Houbei to act as an element of a larger combat system or linked network. For example, its largely passive electromagnetic and electro-optical sensors provide only localized, line-of-sight targeting, preserving the ship's ability to operate undetected but seriously limiting its ability to identify and track targets.[20] The Houbei's surface-search radar cannot provide over-the-horizon targeting (OTHT), and stealthy ships by their nature rarely use active sensors in any case. Houbei's extensive data-link connectivity, however, supports long-range coordination with aircraft, submarines, and other warships.[21] All this points toward a craft optimized to receive over-the-horizon targeting within a larger combat network.[22] Many sources cite China's growing open-ocean OTHT capability, making coordinated antiship Houbei operations more possible.[23] In 2011, a RAND analyst concluded that "China's greatly improved detection, tracking, targeting, and long-range missile systems will soon pose a very real threat to US carrier groups operating to the west of Guam."[24] Offensive missions in the far reaches of all three near seas, however, will require the numbers necessary to make the Houbei a viable offensive arm of the PLAN. If so, the logical implication is that it will be unavailable for coastal-defense missions.

Eight long-range YJ-83 (C803, 135 nm range) antiship cruise missiles provide the Houbei's offensive punch.[25] A study by the U.S. Office of Naval Intelligence (ONI) highlighted the YJ-83 and follow-on antiship cruise-missile threat: "Future anti-ship cruise missiles are expected to continue to utilize advanced seeker capabilities including the expanded use of millimeter wave seekers and the possible use of coherent radar seekers that allow enhanced countermeasure discrimination."[26] Just a single YJ-83 would be a serious potential threat to a U.S. carrier or expeditionary strike group, but Chinese naval tacticians do not envision single-missile strikes against adversary capital ships.[27] Hence, seen as a larger combat system, externally cued Houbeis become much more than coastal-defense craft.

Houbei's "semistealth," speed and volume antiship-cruise-missile fires also make it a potentially lethal element within a stratagem of offensive surprise. The importance of the Chinese concept of the "assassin's mace" is well known, but many analysts still associate PLAN near-seas capabilities within an antiaccess and area-denial (A2/AD) paradigm—that is, largely defensive in nature. Alongside an increasing fleet of long-range antiship cruise-missile platforms, the Houbei class provides a distinctly offensive potential capability within the active-defense strategy.[28] A recent RAND assessment points out that Chinese writings stress preemptive attacks on key U.S. power-projection capabilities—including aircraft carriers—prior to or quickly following formal declaration of hostilities. This stratagem is designed to disrupt the deployment of forces to the region, place Washington in a passive position, and deliver a psychological shock to the United States and its allies.[29] RAND goes farther, to state that an aircraft carrier with escort, if surprised, would be particularly vulnerable to a saturation missile attack. Chinese descriptions of Houbei fast attack craft consistently stress covert, long-range attacks taking advantage of stealth, surprise, and standoff ranges.

A final factor that supports the idea of the offensive nature of the Houbei class is the fact that new Chinese coastal-defense cruise-missile (CDCM) capabilities are lessening the need for coastal-defense craft, freeing up the Houbei for missions farther out in the near seas—though, again, they cannot replicate the roles or missions of offshore-patrol vessels. The YJ-62 CDCM is becoming the coastal-defense workhorse. With its reported 160 nm range, it provides China with significant long-range coastal defense, well beyond the 20 nm range of the dated YJ-8/C801 antiship cruise missile found on older coastal-defense craft.[30] *Jane's* asserts that as many as 120 of these new systems had been deployed opposite Taiwan by 2012.[31] With improved OTHT and target-discrimination sensors and techniques—such as over-the-horizon backscatter and surface-wave radars—the need for an antiship cruise missile or more guided-missile craft for coastal defense is arguably minimized (though offshore-patrol vessels are certainly still required).[32] The logical implication is that the PLAN will continue to let the number of coastal-defense hulls drop as the YJ-62 and follow-on coastal-defense cruise missiles and networked intelligence, surveillance, and reconnaissance (ISR) systems solidify coverage over the Chinese littoral.

Differing Expert Views

As of 2009, however, ONI did not seem to view the Houbei as an offensive fast attack craft, describing it instead as a "coastal defense and near-littoral" *patrol* craft.[33] This author argues, however, that the Houbei's role is potentially much greater than patrol. First, China did not design it for long-endurance patrols. The Houbei is no offshore-patrol vessel; minimal fuel capacity, a small crew, marginal "hotel services," largely passive sensors, and a lack of embarked small craft make it incompatible with patrol duties. The U.S. Naval War College's Andrew Erickson seems to agree, asserting that Houbeis are integral to Chinese offensive concepts of operations, whether targeting Taiwanese navy surface units in a cross-strait conflict or U.S. carrier strike groups with multiaxis, saturation antiship cruise-missile attacks.[34] Nan Li, also of the Naval War College, argues that the most likely role of the Houbei is "active defense of China's 'near seas,' representing the country's attempts to gain greater *sea control* further from its landmass."[35] If the Houbei has an offensive role as argued, the A2/AD terminology commonly applied to the PLAN may not be fully satisfactory here.[36]

The PLAN could also use Houbeis for missions other than surface warfare. For example, some analysts argue that the Houbei could carry missiles other than antiship cruise missiles, possibly antisubmarine missiles or torpedoes. While the Houbei has no antisubmarine sensors, within a linked fleet it could act simply as a "shooter," just as it can in coordinated surface attacks. Antisubmarine missiles fired from a low-signature, fast surface craft provide the advantages of surprising enemy submarines, not giving away the location of escorting Chinese submarines, and limiting enemy response, in that, as analysts assert, the Houbei would be a hard target for torpedo attack.[37] Finally, some argue that the PLAN could modify the Houbei for land attack cruise missiles, as the missile housing can apparently accommodate C601 and similar weapons of the type.[38] These possibilities remain speculative, though, as no evidence clearly indicates that the PLAN will deploy missiles other than an antiship type on Houbei.

PLAN Houbei Exercise Employment

The greater openness of recent PLAN exercises provides illuminating examples of Houbei employment. Indeed, China has expanded its transparency in recent decades, as manifested by more openness in official discussions on defense and a noteworthy emphasis on new capabilities.[39] Some argue that this transparency is purposeful, that it "functions as a crucial means of conventional deterrence," clearly aimed at Washington.[40] But even beyond denial and deception, especially in light of Beijing's deliberate embellishment of military capabilities, there is the inherent risk of flawed inferences and findings from PLAN exercises.

Recent exercises demonstrate that the PLAN is gradually accomplishing "near-seas active defense" missions, with naval units deploying farther out to provide a defensive barrier, but a barrier with an offensive aspect. The PLAN increasingly integrates fast attack craft in large-scale, joint exercises and operations. For instance, exercise accounts since 2009 emphasize multiaxis, nighttime Houbei missile attacks. Dr. Erickson found that during June–July 2010 joint "anticarrier" East China Sea exercises, Houbeis played an important role with live antiship cruise-missile fires.[41]

Chinese accounts of these exercises and of their training focus also provide important insights into fast-attack-craft roles and missions. An official PLAN description of Houbei training included the following details:

> The flotilla has initially formed up more than ten new tactics including coordinated combat operations along with observation and communication stations and early warning aircraft. . . . Since last year, the flotilla has completed missions including a four-vessel formation in day/night continuous sailing across fleet boundaries, and formation volley launch of missiles in a complex electromagnetic environment. Not long ago, in an opposing-forces training exercise with a formation of the new missile attack craft guided

> by information from a light force in an attack on an enemy formation, a maritime strike force composed of a number of new vessels succeeded in a long-range, beyond-line-of-sight attack, hitting their targets precisely.[42]

This account obviously indicates coordinated, salvo, antiship cruise-missile strikes with external cueing, but it also suggests several secondary missions, such as ISR. Official PLAN media coverage describes Houbei missions as including "maritime defense penetration" and "long-range missile attacks," in coordination with submarines, surface units, and aircraft.[43] Other PLAN accounts give the fast attack craft a supporting role in amphibious operations in the South and East China Seas and in combat operations outside "territorial waters."[44] These descriptions indicate missions well beyond coastal defense. One point of evidence against longer-range Houbei operations, however, is that to date PLAN joint exercises involving the Houbei have fallen within roughly two hundred nautical miles of shore bases.

The PLAN Houbei Imperative

One reason the PLAN developed the Houbei fast attack craft was to counter regional surface fleets. Taipei is obviously Beijing's foremost concern. The majority of Houbeis are homeported within easy range of the Taiwan Strait, in the East and South Sea Fleets. They are ideal for fast response in a crisis or for saturation antiship cruise-missile attacks against Taiwanese combatants in preparation for an amphibious move against the island.[45] Taiwan has sixty-one fast attack guided-missile craft, but the eighteen *Kuang-Hua VI*s, with four Hsiung Feng-2 antiship missiles, make up its force of modern fast attack craft.[46] They represent a capable, if small, sea-denial complement to other Taiwanese surface combatants and CDCMs, but they remain quantitatively and qualitatively inferior to the Houbeis.[47] Taipei must appreciate this, as its developmental nine-hundred-ton, stealthy, catamaran-hull, guided-missile "near-shore frigate," armed with eight Hsiung Feng-3 antiship cruise missiles (with 160 nm range and supersonic speed), is designed both to counter the Houbei threat and provide a more capable sea-denial fleet.[48]

The fleets of other regional states with contiguous waters are also important factors in Beijing's calculations. Vietnam in 2003 purchased from Russia ten Molniya (modernized Tarantul export-variant) fast attack craft, each armed with eight SS-N-25 Switchblade missiles.[49] Alongside the four Gepard-class frigates, this represents a capable Vietnamese navy surface threat, both classes having over twice the Houbei's range and displacement. The even more robust navies of South Korea and Japan are far more capable than Vietnam's of sea control in home waters. While the Philippine navy cannot field even a marginal sea-denial force, Manila, like other U.S. allies, expects American support for defense against Chinese aggression. The Houbei can operate near all these waters and could provide an offensive punch against pro-U.S. Asian navies in a crisis—surely an aspect of Houbei's raison d'être. Yet the PLAN almost certainly acquired the Houbei primarily with the USN in mind.

While a detailed assessment of the employment of massed Houbeis against U.S. strike groups is beyond the scope of this chapter, the previous discussion should suggest the potential threat. One has only to imagine a Taiwan defense scenario with U.S. strike groups closing on the region to appreciate the possibilities: stealth and forty-knot-plus speed allow the positioning of coordinated, dispersed "wolf packs" hundreds of miles off the Chinese coast, hundreds of miles apart, linked with ISR, attack aircraft, and submarines, presenting American warships with multiple-axis fusillades of antiship cruise missiles.[50]

Houbei Class Weaknesses

While an intimidating craft, designed to be a "thorough-bred ship-killer," the Houbei class is not "ten feet tall."[51] Taiwan's military keeps a close eye on Chinese naval developments and describes Houbei's limitations in the same way most analysts do: "short range at high speed, dependence on target data provided by an external command and control network, and reduced stealth at high speed from the stern water plume."[52]

The Houbei's range is indeed a serious limiting factor with respect to its concept of operations and deserves special attention. On the basis of all available information, four hundred nautical miles is a good rough estimate of the extreme of the hull's unrefueled range at operational speeds.[53] At economical speeds, range increases to as much as a thousand nautical miles in good sea conditions, but other factors typically make such speeds impractical. Hence, unrefueled, Houbei is relegated to relatively brief missions within the near seas.

Yet two factors mitigate the effects of Houbei's short legs: the 135 nm range of the C803 (and follow-on antiship cruise missiles), combined with the Houbei's own range, and the potential use of offshore islands or tenders for logistical support can both extend its operational reach.[54] The operative term here is "potential"—a detailed review of current literature reveals a dearth of information on Houbei logistics or operations beyond a few hundred nautical miles. While references to Houbei refueling and berthing at offshore islands and South China Sea outposts exist, the PLAN does not appear to possess a next-generation class of replenishment vessels for smaller combatants.[55] The PLAN would surely task its larger replenishment vessels with out-of-area operations supporting large combatants, making them less available for fast attack craft. An assessment of the existing PLAN inventory suggests that any of the Dazhi, Dalang II, and Dajiang classes of submarine tenders / support ships could serve as fast-attack-craft tenders, but this is speculative.[56] The 2010 Chinese defense white paper does stress, however, that sea-based logistics are a priority, that the PLAN is "working to further improve its surface support capabilities."[57] It is also possible that Chinese naval leaders would simply accept the risk and leave Houbeis to their own devices after a coordinated antiship cruise-missile attack. In fact, some analysts assert that these inexpensive craft ($30 million each) are deemed expendable.[58]

Other commonly cited weaknesses are worth addressing as well. One is the limiting factor of the small crew on extended operations. Endurance is reduced because watch rotations are impossible with a crew of only twelve; human limitations likely prevent missions beyond roughly twenty-four hours. "Creative manning" could help alleviate this situation, but other factors, such as sea state and operations tempo, exacerbate the human factor and make it perhaps as important a limitation as the craft's unrefueled range.[59] Another weakness is reliance on air cover to guarantee freedom to maneuver, especially in a contest with a more capable navy. Houbeis have only limited air defenses of their own—a close-in weapon system and man-portable air-defense missiles—leaving them vulnerable outside the protection of larger combatants or shore-based surface-to-air missiles (SAMs).[60] Still, recent PLAN exercises with Luzhou and Luyang II DDGs and Jankai II FFGs—all with advanced, longer-range SAMs—and land-based Su-30MK2/J-11 series aircraft suggest that sufficient air cover might well support the employment of Houbei at its maximum range. The PLAN also seems intent on optimizing for area air defense follow-on Chinese warships, such as the recently revealed next-generation air-defense destroyer and the refurbished aircraft carrier *Liaoning* (the ex-Russian *Varyag*). The Houbei's HN-900 data-link antenna reportedly links it with larger Chinese surface combatants, supporting the idea that Houbei could participate in coordinated operations under PLAN air/SAM cover.[61]

The Future PLAN Fast-Attack-Craft Force

Geography and contingency planning likely demand a larger PLAN fast-attack-craft force for the coming decades. The vast expanses of China's near seas, for instance, may require fast attack craft in numbers sufficient for crises in more than a single near-seas region at once. Because saturation antiship-cruise-missile attacks require multiple Houbeis, even eighty craft seem insufficient to the task. Maintenance, short range, and crew rest limit how many the PLAN can effectively field at once. While estimates of future orders of battle vary, most analysts assert that Houbei production will continue apace. China is also building two Houbeis for Pakistan, an indicator both that the hull is a proven design and that production will continue.[62] *Jane's* asserts that the PLAN will acquire as many as a hundred, to equip three flotillas, one for each fleet.[63] The South China Sea, however, could well prove to be the hub for Houbei operations. As James Holmes of the Naval War College asserts, "The South China Sea represents the most likely maritime theater for Beijing to deploy armed force, including combined-arms attacks designed to saturate and overpower U.S. task groups' defenses, to realize its geopolitical and strategic aims."[64]

Economically, China can easily support the expansion and modernization of the Houbei force and begin the development of follow-on craft. Chinese journals speculate that future, larger versions of a Houbei-type craft will have a flight deck / hangar and helicopter and may serve as a command-and-control and ISR platform.[65] Beijing's defense budget continues to grow at roughly 12 percent annually, supporting acquisition, research, and development (and most analysts assert that the budget figures are understated).[66] Certainly, as China charts its path to global power status, its navy will expand, including the fast-attack-craft force.

A lesser, but still important, factor is the effectiveness of Chinese quality control in warship manufacture and maintenance, not only to ensure a ready naval force at present but to provide sustained fleet numbers over decades. The struggles that the United States is now facing with this issue demonstrate the priority and funds that fleet maintenance must have to ensure full vessel service lives. China began to modernize its shipyards in the 1990s and Beijing is building at a frenetic pace—the Type 071 Yuzhao-class amphibious dock transport, for instance, was built in only six months.[67] Rapid production with relatively new technologies can be a recipe for lifetime hull and machinery problems affecting readiness and class longevity. Further, aluminum hulls or superstructures (like Houbei's) carry their own slate of corrosion problems. Indeed, since the PLAN would not make Chinese manufacturing and maintenance problems publicly known, it is possible that there is more of a problem than is widely presumed.

Finally, the PLAN still is not yet fully competent in sea control. Fast-attack-craft integration in more complex operations is still nascent and dependent on nearby shore-based or island support. The PLAN is still developing naval strategy, doctrine, and operational concepts, as well as an officer corps skilled in operational art. Still, PLAN leaders admit that these shortcomings exist and seem to be focusing efforts on addressing them, especially with an aggressive training regimen.[68]

Implications

At the theater-strategic level, the PLAN fast-attack-craft evolution is part of the larger PLAN shift to an offensive-oriented, regional, sea-control navy. This shift has implications for the United States and treaty allies in the Asia-Pacific (Australia, Japan, Korea, the Philippines, and Thailand), all increasingly concerned not just with China's military rise but also with its recent aggressive maritime behavior. Conflicting South and East China Seas territorial claims could easily lead to clashes involving the PLAN. Official

U.S. assessments warn that "the U.S.-Chinese military balance in the Pacific could nevertheless influence day-to-day choices made by other Pacific countries, including choices on whether to align their policies more closely with China or the United States."[69] These allies may have to choose among options of expanding their own navies, strengthening anti-China defensive alliances/coalitions, accommodating the rise of a potentially belligerent China, or a combination thereof. Regional defense agreements also carry significant obligations for Washington, should China assert itself more aggressively in coming years. Some American analysts conclude that if the United States and its allies continue to balance the expanding PLAN, another costly arms race may result.[70] As the Houbei class reaches its apex in coming years and the PLAN builds a follow-on fast attack craft, the PLAN transformation path will become clearer.

The PLAN fast-attack-craft evolution holds more specific operational and tactical ramifications for the U.S. Navy. The Houbei's size and partial stealth mean that the USN may never locate with long-range sensors the firing platform in a YJ-83 antiship-cruise-missile launch prior to or after the fact, making prosecution by surface-launched Harpoon difficult at best. Even if located after launch, a Houbei's speed could quickly put it outside the Harpoon engagement envelope. Air-launched Harpoons or aerial cueing may be solutions, but operating friendly aircraft or unmanned aerial systems within range of China's growing fourth-generation naval air defenses raises the risks to these platforms.[71] Hellfire-armed MH-60R helicopters would be similarly vulnerable. Houbei prosecution via submarine seems unlikely, as discussed. Recent U.S. government assessments of the Littoral Combat Ship (LCS) suggest that it too will not be up to the task of Houbei hunter-killer missions in high-threat waters.[72] The most desirable tactic is probably class-wide preemptive mining or in-port destruction, but short of a general war, this is hard to imagine. More subtle means might involve targeting the battle network that makes the Houbei a viable threat or denying the PLAN the ISR that is vital to locating adversary warships.

Another option is to rethink the long-standing argument for a high-low-mix fleet force structure. Since the PLAN fast-attack-craft force is a fleet-scale problem, premised on distributed operations of small, single-mission warships, response in kind may well be a viable option. Indeed, the USN originally envisioned the LCS as a "Streetfighter" to take on warships in the littorals (it has since morphed to a much larger, multimission hull). The concept of preserving combat power via distributed, dispersed operations in the face of a similar threat, espoused by the Naval Postgraduate School's Capt. Wayne Hughes, seems to make sense.[73] Hughes argues that the inherent survivability and combat power achieved through a dispersed fleet of smaller, single-mission ships could preclude the need for larger warships to deal with multiaxis salvos alone. By extension, he would view the current LCS and larger capital ships as potentially too valuable to mix it up in high-threat waters. Another advantage that numerous, dispersed, smaller warships bring is wide-area surveillance—critical for locating low-signature craft like the Houbei. There are obvious operational drawbacks to deploying many small combatants far afield, but the USN has mastered them before. Nevertheless, the Navy is clearly committed to the LCS, despite official government reports that recommend smaller, single-mission hulls.[74]

Other considerations would be important for prosecuting the Houbei threat. First, if one assumes that USN units cannot locate the Houbei before launch, the Aegis system will have to be up to the task of fleet air and missile defense. Ostensibly, carrier air wings would augment Aegis, but current air-wing aircraft mix, training, and operations are weighted heavily toward strike; their proficiency in eliminating massed, multiaxis antiship-cruise-missile salvos should not be assumed. As James Holmes points out, "U.S. commanders can expect a 360-degree threat environment" of dispersed, massed, multifaceted attacks.[75] This scenario is no easy one for the carrier strike group. Further, small, agile targets like the Houbei amid a cluttered near-seas environment will demand next-generation precision and discriminating terminal guidance for friendly maritime standoff weapons. Harpoon's obsolescence in both range and target discrimination is a stark current USN standoff weakness that demands a near-term remedy.[76] Wide-area target identification is another requirement that seems to need improvement. Stealthy unmanned aerial vehicles may offer promising solutions, but an overreliance on technological solutions has proved illusory in the past. In fairness, naval and air theorists are currently working on, under the "AirSea Battle" rubric, joint U.S. Navy / Air Force approaches to dealing with PLAN A2/AD threats, but the work remains conceptual for now.[77]

This chapter has argued that the PLAN Houbei fast-attack-craft force will play an offensive role within the near seas in a Chinese navy shifting from sea-denial to sea-control capabilities. While gaps in the evidence exist, Chinese doctrine and operational concepts, accounts of PLAN exercises and operations, and numerous expert studies provide sufficient information to make a balanced assessment. The PLAN seems to aspire to a near-seas sea-control navy within the next decade, and fast attack craft will arguably represent an important element within a linked fleet designed to bring the fight to navies in both green and blue water. Prudence demands that naval strategists avoid discounting the offensive potential of PLAN fast attack craft in the near seas and that tacticians account for these craft long before missile endgame.

Notes

1. U.S. Joint Forces Command, *The Joint Operating Environment* (Suffolk, Va.: 25 November 2008), p. 24.
2. Opinions vary on the distances associated with "coastal" and "littoral," but for this paper they are synonymous and imply ranges out to roughly fifty nautical miles (nm). The exclusive

economic zone extends to two hundred nautical miles, and the "near seas" to the First Island Chain, or as far as five hundred nautical miles.

3. See Ting Yu, "Complete Remake or 'Old Medicine in a New Bottle': A Brief Discussion of the Role and Application of the Type 022 Stealth Missile Boat," *Xiandai Bingqi* (Beijing), 2 September 2008, pp. 35–43.

4. Office of Naval Intelligence [hereafter ONI], *China's Navy 2007,* p. 39, available at www.fas .org/. While analysts sometimes include the later generation of lightly armed offshore-patrol vessels under the fast-attack-craft rubric, this paper will focus on the contemporary fast-attack-craft force, which technically does not include offshore-patrol vessels.

5. Nan Li, "The Evolution of China's Naval Strategy and Capabilities: From 'Near Coast' and 'Near Seas' to 'Far Seas,'" *Asian Security* 5, no. 2 (2009), p. 148.

6. Later offshore-patrol vessels had better range and endurance, but this author argues that these are not true fast attack craft.

7. Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 8 June 2011), p. 42. The U.S. Department of Defense (DoD) assesses the total fast attack force consisted of eighty-five hulls by 2010: see U.S. Defense Dept., *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China* (Washington, D.C.: Office of the Secretary of Defense, 2010), p. 2, available at www.defense .gov/.

8. U.S. Senate, *Security Issues: Strategic Perceptions,* hearing, U.S.-China Security Review Commission, 3 August 2001, p. 448, available at origin .www.uscc.gov/. The Molniya is an improved version of the Russian Tarantul guided-missile patrol craft, with forty-knot-plus speed, a 76 mm gun, and two SS-N-22, or four SS-N-25, antiship cruise missiles.

9. ONI, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics* (Washington, D.C.: Navy Maritime Intelligence Center, August 2009), p. 20, www.oni.navy.mil/. ONI and other sources indicate that the Australian Small Waterplane Area Twin Hull (SWATH) design is particularly well suited for higher sea states where monohull vessels would be less able to operate.

10. *Jane's Sentinel Security Assessment: China and Northeast Asia,* s.v. "China: Procurement," 17 January 2011, www.janes.com/.

11. Houbeis are clearly integrated as higher-end elements of near-seas operations and exercises, whereas older fast attack craft are not. See Joseph Carrigan, "Aging Tigers, Mighty Dragons: China's Bifurcated Surface Fleet," Jamestown Foundation *China Brief* 10, no. 19 (September 2010), pp. 2–5. Claims of eighty Houbeis can be found in press accounts, though DoD's 2012 *Annual Report to Congress* on China reports sixty.

12. While Admiral Liu also envisioned "far seas" missions, they were evolutionary in nature and in any case would not involve fast attack craft. See Daniel J. Kostecka, "From the Sea: PLA Doctrine and the Employment of Sea-Based Airpower," *Naval War College Review* 64, no. 3 (Summer 2011), pp. 11–30.

13. James R. Holmes, "China's Maritime Strategy Is More than Naval Strategy," Jamestown Foundation *China Brief* 11, no. 6 (April 2011), p. 10. Senior Chinese navy officials in 2011 revealed that a "maritime security strategy is under study." See Russell Hsiao, "Military Delegates Call for National Maritime Strategy to Protect Expanding Interests," Jamestown Foundation *China Brief* 11, no. 4 (March 2011), p. 1.

14. Nan Li, "Evolution of China's Naval Strategy and Capabilities," p. 145. Both improved operational reach/endurance and offensive capabilities in the near- and far-seas concepts are important elements of the PLAN transformation relevant to fast attack craft. Fast attack craft represent one node in a larger network of near-seas forces.

15. Daniel M. Hartnett, *Towards a Globally Focused Chinese Military: The Historic Missions of the Chinese Armed Forces* (Alexandria, Va.: Center for Naval Analyses, June 2008), p. 14.

16. Nan Li, "Evolution of China's Naval Strategy and Capabilities," p. 161; Christopher D. Yung and Ross Rustici, with Isaac Kardon and Joshua Wiseman, *China's Out of Area Naval Operations: Case Studies, Trajectories, Obstacles, and Potential Solutions,* China Strategic Perspectives, no. 3 (Washington, D.C.: Institute for National Strategic Studies [hereafter INSS], December 2010), p. 2, www.ndu.edu/.

17. Cortez Cooper, *The PLA Navy's "New Historic Missions": Expanding Capabilities for a Re-emergent Maritime Power,* testimony presented before the U.S.-China Economic and Security Review Commission (Santa Monica, Calif.: RAND, 11 June 2009), p. 7.

18. Andrew Yang, *The Military of the People's Republic of China: Strategy and Implementation,* UNISCI Discussion Papers, no. 17 (Zurich, Switz.: May 2008), p. 189, available at www .ebscohost.com/.

19. *Jane's Sentinel Security Assessment: China and Northeast Asia,* s.v. "China: Navy," 9 December 2010, www.janes.com/.
20. James C. Bussert, "Catamarans Glide through Chinese Waters," *Signal,* 3 December 2007.
21. ONI, *People's Liberation Army Navy,* p. 18.
22. This is the author's assessment, based on assertions from ONI and the Office of the Secretary of Defense. See U.S. Defense Dept., *Annual Report to Congress: Military Power of the People's Republic of China* (Washington, D.C.: Office of the Secretary of Defense, 2009), p. 49, and ONI, *People's Liberation Army Navy,* p. 18. See also James Bussert, "Chinese Warships Struggle to Meet New Command, Control and Communications Needs," *Signal,* February 2009, p. 44, www.afcea.org/.
23. For OTHT capability, U.S. Defense Dept., *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China* (Washington, D.C.: Office of the Secretary of Defense, May 2012), p. 22.
24. Cortez Cooper, *Joint Anti-access Operations: China's "System-of-Systems" Approach,* testimony presented before the U.S.-China Economic and Security Review Commission (Santa Monica, Calif.: RAND, 27 January 2011), p. 12.
25. U.S. Defense Dept., *Annual Report to Congress* (2009), p. 49. ONI lists the range as ninety-five nautical miles; see ONI, *People's Liberation Army Navy,* p. 28. This paper uses the 135 nm range found in Thomas Mahnken, *The Cruise Missile Challenge* (Washington, D.C.: Center for Strategic and Budgetary Assessments [hereafter CSBA], March 2005), p. 15. See also U.S. Defense Dept., *Annual Report to Congress* (2012), p. 23.
26. ONI, *People's Liberation Army Navy,* p. 28.
27. L. C. Russell Hsiao, "China Unveils Sea Defense System to Counter Aircraft Carrier," Jamestown Foundation *China Brief* 10, no. 23 (November 2010), p. 2. Graphics of official Chinese presentations at arms shows portray unmanned aerial vehicles and submarines cueing multiplatform, antiship cruise-missile salvos directed at U.S. carriers.
28. U.S. Defense Dept., *Annual Report to Congress* (2010), p. 10.
29. Roger Cliff et al., *Entering the Dragon's Lair: The Implications of Chinese Anti-access Strategies* (Santa Monica, Calif.: RAND, 2007), p. 31.
30. *Jane's World Navies,* s.v. "China," 17 January 2011, www.janes.ins.com/. See also U.S. Defense Dept., *Annual Report to Congress* (2012), p. 21.
31. *Jane's Sentinel Security Assessment:* "Navy: China and Northeast Asia," October 2012.
32. For backscatter and surface-wave radars, Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 3 February 2011), p. 37.
33. ONI, *People's Liberation Army Navy,* p. 18.
34. Andrew Erickson, "Chinese Anti-ship Cruise Missile Firing as Part of Combined Arms Anti-carrier Exercises in East China Sea, 30 June–5 July," *Andrew S. Erickson: China Analysis from Original Sources* (blog), 6 July 2010, www.andrewerickson.com/ [hereafter "Chinese Anti-ship Cruise Missile Firing"].
35. Nan Li, "All at Sea: China's Navy Develops Fast Attack Craft," *Jane's Intelligence Review* (September 2009) [emphasis added].
36. Roger Cliff, a China expert at the RAND Corporation, seems to agree. See his *Anti-access Measures in Chinese Defense Strategy,* testimony before the U.S.-China Economic and Security Review Commission (Santa Monica, Calif.: RAND, 27 January 2011), p. 2.
37. Nan Li, "All at Sea."
38. Ting Yu, "Complete Remake or 'Old Medicine in a New Bottle.'"
39. Michael Kiselycznyk and Phillip C. Saunders, *Assessing Chinese Military Transparency,* China Strategic Perspectives, no. 1 (Washington, D.C.: INSS, June 2010), p. 4.
40. For quote, "Transparent Drills Add Edge to Deterrence" (editorial), *Global Times Online* (Beijing), 1 July 2010.
41. Erickson, "Chinese Anti-ship Cruise Missile Firing."
42. Liao Haifeng, "East Sea Fleet Missile Boat Flotilla Strengthens Building of Combat Power with New Equipment," *Renmin Haijun,* 9 July 2008, p. 4.
43. "Military Report," *CCTV-7* (Beijing), 21 November 2010.
44. Liu Yue-shan, "'Stealth Assassin' Goes into Action during Four Troop Training Exercises within a Month: Frequent Drills of Long-Range Strikes," *Wen Wei Po News Center* (Beijing), 30 July 2010. Beijing often asserts that that it has the right to regulate foreign military activities in its two-hundred-mile maritime EEZ. See Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 22 April 2011), p. 82.

45. For Houbei home ports, U.S. Defense Dept., *Annual Report to Congress* (2010), p. 65.

46. Anthony Cordesman and Robert Hammond, *The Military Balance in Asia: 1990–2010* (Washington, D.C.: Center for Strategic and International Studies, 14 September 2010), p. 63; and *Jane's Sentinel Security Assessment: China and Northeast Asia,* s.v. "Taiwan: Procurement," 18 February 2011.

47. James R. Holmes and Toshi Yoshihara, "Taiwan's Navy: Able to Deny Command of the Sea?," Jamestown Foundation *China Brief* 10, no. 8 (April 2010), p. 9. With a shorter missile range, slower speed, very limited stealth protection, and small numbers, it could neither achieve a crushing first blow against the PLAN nor likely survive alone a contest with Chinese fast attack craft.

48. Ch'ian Hsing, "Missile Fast Boat Update: Comparison with PLAN Fast Boat," *Defense International,* October 2009. For range and speed, "Hsiung Feng Anti-ship Cruise Missile," MilitaryPeriscope.com, 1 April 2009.

49. Richard F. Grimmett, *Conventional Arms Transfers to Developing Nations, 1996–2003,* Congressional Research Service Report to Congress (Washington, D.C.: Congressional Research Service, 26 August 2004), p. 8.

50. For stealth and speed, ONI, *People's Liberation Army Navy,* p. 20. For "wolf packs," "China's Three-Point Naval Strategy," International Institute for Strategic Studies *Strategic Comments* 16, comment 37 (October 2010), www.iiss.org/.

51. See John Patch, "A Thoroughbred Ship-Killer," U.S. Naval Institute *Proceedings* 136, no. 4 (April 2010), pp. 48–53.

52. Ch'ian Hsing, "Missile Fast Boat Update."

53. The author's experience with similar-sized small craft provides context and experience for this figure, an estimate. This author defines "operational speed" as a combination of low speeds for transit and higher speeds and sprints in combat. Prudent operations should extend the range. Nan Li argues for an operational range of three hundred nautical miles; Nan Li, "All at Sea."

54. The C803's extended range (reportedly 135-plus nm), higher speed (though not likely supersonic, as some claim), enhanced countermeasures, and reported ability to receive target information in flight make this a formidable missile. See Mahnken, *Cruise Missile Challenge,* p. 15.

55. A single Danyao-class South China Sea replenishment vessel became operational in 2007; *Jane's World Navies,* s.v. "China." China does not appear to have built any other smaller fleet logistics vessels since the 1970s.

56. Eric Wertheim, *The Naval Institute Guide to Combat Fleets of the World,* 15th ed. (Annapolis, Md.: Naval Institute Press, 2007), p. 134.

57. People's Republic of China, *China's National Defense in 2010* (Beijing: Information Office of the State Council, March 2011), available at news.xinhuanet.com/.

58. Erickson, "Chinese Anti-ship Cruise Missile Firing." Dr. Erickson concurs that the Houbei might be viewed by the PLAN as expendable; see Erickson and David D. Yang, "Using the Land to Control the Sea? Chinese Analysts Consider the Antiship Ballistic Missile," *Naval War College Review* 62, no. 4 (Autumn 2009), p. 74. In contrast to the estimate of $30 million, Professor Nan Li of the Naval War College asserts that the Houbeis cost as little as $14.3 million each. See Nan Li, "All at Sea," pp. 2–3.

59. Definitive data are not available on the highest sea state in which the Houbei can operate, but a safe estimate seems to be sea state 4, based on comparison to U.S. trimaran designs, which can operate in up to sea state 5.

60. ONI, *People's Liberation Army Navy,* p. 20. DoD assesses that they carry eight; U.S. Defense Dept., *Annual Report to Congress* (2010), p. 3.

61. Bussert, "Chinese Warships Struggle to Meet New Command, Control and Communications Needs," p. 44.

62. "Construction of Fast Attack Craft Starts for Pakistan Navy," *Pakistan Defence* (Dubai), 2 March 2011, www.defence.pk/.

63. Nan Li, "All at Sea," p. 3. For the figure of one hundred, Stephen Saunders, comp., *Jane's Fighting Ships 2010–2011* (Coulsdon, Surrey, U.K.: IHS Jane's, 2010), p. 149.

64. James Holmes, "China's Way of Naval War: Mahan's Logic, Mao's Grammar," *Comparative Strategy* 28, no. 3 (2009), p. 218.

65. Richard D. Fisher, *Chinese Naval System Modernization Trends,* testimony before the U.S.-China Economic and Security Review Commission, 11 June 2009, p. 16, available at www.strategycenter.net/. See also *Jane's Sentinel Security Assessment,* "China: Procurement." This may be an exploratory effort to address class shortcomings.

66. For 12 percent growth, U.S. Defense Dept., *Annual Report to Congress* (2010), p. 41. See also Keith Crane et al., *Modernizing China's Military: Opportunities and Constraints* (Santa Monica, Calif.: RAND, 2005), p. xx.

67. Fisher, *Chinese Naval System Modernization Trends.*

68. Zhou Ming, "Bending the Bow, Sharpening the Sword, Being Ready to Fight: An Overall Review of the Navy's Military Work and Force Building Achievements in the '11th Five-Year Program' Period," *Renmin Haijun,* 29 October 2010, p. 5.

69. Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Washington, D.C.: Congressional Research Service, 26 April 2013), p. 2.

70. Ibid., p. 25.

71. U.S. Defense Dept., *Annual Report to Congress* (2009), p. 22.

72. See John Patch, "The Wrong Ship at the Wrong Time," U.S. Naval Institute *Proceedings* 137, no. 1 (January 2011), p. 18.

73. See Wayne P. Hughes, Jr., *Fleet Tactics: Theory and Practice* (Annapolis, Md.: Naval Institute Press, 1986).

74. Duncan Long and Stuart Johnson, "The Littoral Combat Ship: From Concept to Program" (National Defense University, Washington, D.C., March 2007), p. 2. See also O'Rourke, *China Naval Modernization* (26 April 2013), p. 83; Bryan J. Christiansen, "Littoral Combat Vessels: Analysis and Comparison of Designs" (thesis, Naval Postgraduate School, Monterey, Calif., September 2008); and U.S. Government Accountability Office, *Defense Acquisitions: Navy's Ability to Overcome Challenges Facing the Littoral Combat Ship Will Determine Eventual Capabilities* (Washington, D.C.: August 2010), p. 38.

75. Holmes, "China's Way of Naval War," p. 230. While this threat has many similarities to the Cold War Soviet antiship-cruise-missile tactics, it involves more-capable missiles, potentially in greater numbers.

76. See John Patch, "Regain ASCM Standoff: Improve the Harpoon," U.S. Naval Institute *Proceedings* 136, no. 6 (June 2010), pp. 79–80. See also Holmes, "China's Way of Naval War," p. 236.

77. See Jan van Tol, *AirSea Battle: A Point-of-Departure Operational Concept* (Washington, D.C.: CSBA, January 2010).

CHAPTER TWO

Underwater TELs and China's Antisubmarine Warfare

Evolving Strength and a Calculated Weakness

William S. Murray

Beijing's impressive program of submarine force modernization suggests an expensive wager on that force's enduring ability to accomplish vital near-seas missions in foreseeable military contingencies. Since the mid-1990s, China has launched or acquired more than thirty-five submarines, constituting five new classes of vessels; has essentially retired what had been its most numerous class of diesel-electric submarines (SSs); and has carved out of solid rock at Yalong Bay, on Hainan Island, an entirely new submarine base for new classes of nuclear-powered attack submarines (SSNs) and nuclear-powered ballistic-missile submarines (SSBNs).

This chapter will attempt to assess how China may intend to employ those new submarines. The conclusions drawn from this analysis are admittedly speculative, but they are based on facts and are internally reinforcing and coherent; also, they integrate well with what is known about other aspects of China's antiaccess and area-denial forces.[1]

Current Mission: Taiwan and the Near Seas

Beijing is quite open about what constitutes its vital interests, stating that "China's number-one core interest is to maintain its fundamental system and state security; next is state sovereignty and territorial integrity; and third is the continued stable development of the economy and society."[2] In this oft-stated formulation, "territorial integrity," insofar as it applies to naval affairs, clearly centers on Taiwan, notwithstanding China's recent aggressive behavior into the East and South China Seas. This primacy of interest is recognized clearly in the West, as reflected on the first page of the *Annual Report to Congress* for 2010 of the U.S. Department of Defense (DoD), which notes that much of China's military modernization is consistent with a near-term focus on preparing for Taiwan Strait contingencies.

Much, perhaps nearly all, of the modernization of the People's Liberation Army (PLA) has clear utility in scenarios involving military coercion of Taiwan. The Second Artillery Corps's short-range ballistic missiles are a prime example; they offer Beijing a large inventory of precision-guided munitions that can with little or no warning cripple or destroy Taipei's air force and navy. The newest People's Liberation Army Navy (PLAN) surface shipbuilding and weapons developments also seem tailored for a Taiwan scenario; so too, I will argue, is China's nonstrategic submarine force. But all these segments of the PLA likely have, in addition to whatever missions they are assigned against Taiwan's forces, a near-seas mission to deter U.S. Navy intervention, and, if that deterrence fails, to destroy reliably strike forces operating within a carrier air wing's range of Taiwan.[3]

History and reflexive mirror-imaging would suggest that PLAN submarines can best accomplish such a wartime mission by employing torpedoes against opposing surface warships. The 1971 sinking of the Indian corvette *Khukri* by the Pakistani *Daphne*-class diesel-electric submarine *Hangor,* the 1981 sinking of the Argentine cruiser *General Belgrano* by the SSN HMS *Conqueror,* and the March 2009 destruction of the South Korean navy corvette *Cheonan* by a single heavyweight torpedo fired from a North Korean midget submarine all attest to the deadly potential of this form of warfare. Further, nearly all warships sunk by submarine in World Wars I and II were victims of torpedoes.

Yet there are strong reasons to question why the PLAN submarine force would choose this mode as its primary means of antisurface warfare. For one, shooting a torpedo (which by maritime standards is a short-range weapon) requires the submarine to operate within lethal range of its adversary's antisubmarine warfare (ASW) weapons and sensors. For another, mastering the key tasks necessary for successful open-ocean torpedo attacks against a capable adversary requires visible, rigorous, and extensive at-sea practice, preferably in the areas in which battles would be fought. Certainly shore-based trainers and computer simulation can assist in developing the necessary skills, but for conventional naval war-fighting proficiency there is no substitute for rigorous training at sea. China's submariners probably remain weak in this area, despite recent attempts to correct this deficiency.

A 2009 Office of Naval Intelligence report stated that the PLAN submarine force was "placing greater emphasis on long range surface and submarine patrols, which allow expanded opportunities to practice the technical and tactical skills that will be required in modern wartime operating environments."[4] The report also notes, "When compared to the historical levels of the past two decades, the number of submarine patrols has more than tripled."[5] However, the tripling of a very low number produces a number that is still low, implying that only a small percentage of China's submariners benefit from deployments in which they might encounter a future adversary.[6] The overall force's ability to find and destroy warships in the open ocean with torpedoes remains an open question.

Furthermore, owing to their slow speed and limited endurance, diesel submarines (which account for over 90 percent of the PLAN's submarine order of battle) are relatively ill suited to open-ocean, torpedo-based antisurface warfare (ASUW) such as might be required in conflict over Taiwan in the near seas.[7] Despite much speculation to the contrary, air-independent propulsion (AIP) does not significantly alter this stark fact, because AIP does not address the fundamental constraint on the conventionally powered submarine in the open ocean—its relatively low speed while submerged. Faster, quiet, nuclear-powered attack submarines certainly could provide much greater tactical flexibility and offset some of these disadvantages. Yet China's handful of noisy first- and second-generation SSNs would not long survive in the deep waters of the near seas against a capable adversary. Nor, for the same reasons, could Chinese SSNs be expected to perform a meaningful wartime role in more remote settings, such as the Indian Ocean, where their lack of stealth would make them vulnerable.

These factors all suggest that China cannot rely on torpedoes as the primary means by which to wring maximum combat effectiveness from any of its submarines. Yet China has invested heavily in its submarine force and doubtless expects to be able to use its submarines effectively, especially in a Taiwan conflict. It is therefore likely that the PLAN has committed itself to ASUW by antiship cruise missiles (ASCMs).

Antisurface Warfare via Antiship Cruise Missiles

The evidence for this important shift is somewhat circumstantial but accords fully with the technology available to China; with the ASUW mission expected of PLAN tactical submarines; with the mode of ASUW adopted by the PLA surface navy, air forces, and Second Artillery Corps; with important historical examples; and with the relatively low amount of at-sea training conducted by Beijing's submarines. For example, regarding the availability of long-range antiship cruise missiles, China in 2007 took delivery of the last of eight Kilo 636M diesel-electric submarines purchased in 2002 armed with (aside from modern wire-guided and wake-homing torpedoes) the Russian SS-N-27B ASCM.[8] This missile can deliver a 440-pound warhead to a range of 120–160 nautical miles (nm), with a terminal phase consisting of a Mach 2.9 "zig-zag flight path."[9]

Additionally, in 2010 DoD reported that "the *Song* SS, *Yuan* SS, and *Shang* SSN will be capable of launching the new CH-SS-NX-13 ASCM, once the missile completes development and testing" and that these three classes of attack submarines, along with the Kilo class, will be "capable of firing advanced ASCMs."[10] One can logically surmise that the CH-SS-NX-13 antiship cruise missile will represent a significant threat to surface naval forces. Until further performance data regarding it are available, observers can only speculate about how advanced the missile will be, but there is little reason to believe it will not constitute a considerable improvement over the approximately twenty-nautical-mile-range submarine-launched subsonic C-801 ASCM the Song currently carries.

China's commitment to advanced naval cruise missiles is already clear in its surface fleet. Nearly every PLAN surface combatant carries ninety-seven-nautical-mile-range, subsonic YJ-83 antiship cruise missiles—typically eight but up to sixteen. The Luyang II destroyers are exceptions, carrying eight 151-nautical-mile-range YJ-62s;[11] so also are the four *Sovremenny*-class destroyers China purchased from Russia, each with eight 120-nautical-mile-range supersonic SS-N-22 antiship cruise missiles. This ASCM reliance is reflected especially strongly in the PLAN's sixty-odd Houbei-class fast attack, wave-piercing catamarans, each of which can carry eight YJ-83s.[12]

Other PLA branches have also wagered heavily on ASCMs. This is indicated by the display of land-based, mobile YJ-62 transporter-erector-launchers (TELs) during the 1 October 2009 National Day parade in Beijing.[13] The PLA Air Force and PLAN aviation have also invested in high-performance ASCMs; many images have appeared on the Internet of B-6 bombers and smaller aircraft carrying ASCMs, including, as of early 2013, the supersonic YJ-12.[14]

China's emphasis on cruise missiles launched from surface ships, aircraft, and submarines has a notable Soviet/Russian precedent. The Soviets built *Sovremenny*- and *Slava*-class cruisers and deployed both Blackjack and Backfire bombers as means of delivering advanced antiship cruise missiles against their most likely opponents. They also built specialized submarines of the Echo II, Charlie I and II, and Oscar classes—all of which carried large numbers of increasingly advanced ASCMs—to compound the missile threat that NATO surface ships faced. The PLA has long equipped its surface ships with early-generation antiship cruise missiles. What is different now is that all of China's surface combatants, many of its aircraft, and all its modern attack submarines are already able, or in the near future will be, to carry and shoot advanced, long-range, lethal cruise missiles. This is a significant change.

The Need for Targeting Data

Nearly all tactical methods of accurately firing long-range ASCMs by any vessel or aircraft rely on remote targeting.[15] Determining the requirements for a surveillance and reconnaissance complex adequate to this task and assessing whether China already possesses one or is on path to do so soon are addressed in this volume by Andrew Erickson. For present purposes, it seems reasonable to assume that China has assessed what is necessary and is investing aggressively to satisfy those requirements. The PLA's over-the-horizon (OTH) radar development and ever-improving constellation of reconnaissance satellites are strong indicators of this;[16] the same is true of the fielding by the Second Artillery Corps of the DF-21D antiship ballistic missile (ASBM). An American vice admiral related in January 2011 that China likely has sufficient satellite and non-space-based intelligence, surveillance, and reconnaissance capability to support DF-21D employment.[17]

The targeting data necessary for a DF-21D engagement could also be provided to other entities, including aircraft, ships, and submarines carrying long-range antiship cruise missiles. As for submarine shooters, there are many ways of delivering such targeting information to patrolling units, including via satellite and by radio transmission, whether high- or midfrequency or, especially, very low frequency (VLF). The great advantage of VLF signals is their ability to penetrate water to tactically useful depths. This means that a receiving submarine does not have to extend an antenna above the ocean's surface (and hence raise its risk of being detected by radar) to receive missile targeting data and firing orders, as it would if receiving satellite or high-frequency transmissions (which cannot penetrate water). Instead, the VLF radio signal can be received on a buoyant or even fully submerged wire antenna, while the submarine itself remains fully underwater.[18] There is some evidence China has developed a submarine antenna for this purpose. Many of the most recent Yuan and Song submarines have what appear to be "bell mouth" openings at the top, aft ends of their sails from which wire antennas could be streamed.[19] Through such an antenna VLF radio waves could convey to the submarine the latitude and longitude of the target, the salvo size and composition of the attack, and the desired time of arrival of the missiles. Onboard computers could then determine the launch times and missile flight paths necessary to satisfy the orders.[20] The submarine crew would have only to enter those data into the missiles through the ship's fire-control system and then fire them. In essence, PLAN submarines would be underwater analogs to the Second Artillery's ballistic-missile TELs. They could deploy in a crisis and hide quietly for extended periods until provided with targeting information and ordered to launch.

This mode, or concept of operation, has a number of benefits. It would require relatively modest submarine crew proficiency and therefore minimal at-sea training. Much of the process could be practiced ashore in computer-assisted training facilities, even alongside a pier. All of this is consistent with computer-based training facilities and scenarios demonstrated to Westerners at Qingdao Submarine Academy and with the levels of PLAN submarine at-sea training that have been observed. It would also accommodate a rigid and centralized command and control of submarines, something that would probably be attractive to senior members of the Chinese Communist Party. It also appears consistent with an otherwise inexplicable event of September 2010.

Another New Class of Submarine Launched

In September 2010, Wuhan shipyard of the China Shipbuilding Industry Corporation (CSIC) launched a new class of submarine. Internet photos show that this vessel incorporates characteristics of the Yuan, Kilo, and Golf classes of diesel submarines. It is probably the largest conventionally powered submarine in existence. Perhaps its most distinguishing feature is its large, even enormous, sail, approximately twice as long and wide as that on the Yuan class. Such a departure from existing norms of submarine structure must have a compelling basis in intended function.

It is possible that this new vessel is simply a replacement for the solitary, fifty-year-old Golf conventionally powered ballistic-missile submarine (SSB) that the PLAN has used to test and develop JL-1 and JL-2 missiles.[21] Yet the Golf emerged apparently shipshape from a Lüshun dry dock in July 2009 and received in January 2011 an effusive official commendation for its successes in conducting missile tests. A CCTV-1 focus of that month depicted the ship in good repair and suggests that it is fully capable of continuing its missile-testing role.[22] A Google Earth image dated 29 March 2011 shows the Golf tied up across a pier from two Yuan SSs and near two Jin SSBNs at Xiaopingdao. So, the Golf appears to have been fully operational as late as 2011. Even if the Golf were soon to be decommissioned, the PLAN could test the JL-2 submarine-launched ballistic missile (SLBM) with either of its two Jin SSBNs rather than build an entirely new vessel. It is therefore likely that the new submarine was built not as a replacement for the Golf or as a JL-2 testing platform but for some other role.

Possible insight into that role can be gleaned from a series of detailed drawings of this submarine in the November 2010 issue of the Chinese magazine *Modern Ships*.[23] This magazine is published by CSIC, which built the mysterious submarine.[24] Two images (in a full-color foldout insert) depict ten vertical-launch missile-tube hatches, sized appropriately for cruise missiles, in the aft end of the sail. These images show that the vessel also has six horizontal torpedo tubes, arranged in a two-over-four configuration like that of the Kilo and Yuan classes. Conceivably, then, this new submarine could launch in quick succession sixteen ASCMs (six from the torpedo tubes and ten from the vertical tubes in the sail) at a solitary target, perhaps at great range.[25] In fact, the author of the *Modern Ships* article observes that "in the course of high-intensity naval combat or to attack enemy land targets, medium-range missiles shot from torpedo tubes cannot meet requirements" and that "the challenge of making vertical launch tubes [for submarines] is not too difficult, but the benefits of this technology for increasing [submarine] combat capability are considerable." The article adds, "Vertical tubes allow for a large salvo shot in a short amount of time . . . affording adversary enemy air defenses no possibility to respond."[26] This would be the first submarine in the PLA inventory to have vertical-launch tubes for antiship cruise missiles (or eventually even land-attack cruise missiles).

Still, questions regarding this submarine's configuration and roles remain. A 13 May 2011 Internet photo of the submarine in dry dock revealed a large bulge extending below the keel directly underneath the sail.[27] Soviet (and presumably also Chinese) Golf-class SSBs had similar bulges to accommodate the thirty-nine-foot ballistic missiles that the twenty-one-foot-diameter boats carried in their sails. This new keel bulge strongly suggests China's newest diesel submarine could or will carry one or more SLBMs. But another photo, posted two weeks later, appears to show twenty hatches along the aft, top portion of the sail, on the port side, roughly consistent with artist's renderings published in *Modern Ships* six months earlier.[28] If this vessel does turn out to have ten or more vertical-launch tubes in its sail, then it stands to reason that China will build more of these or similar submarines and thereby make possible very large salvos of advanced ASCMs.

It also seems logical that this new submarine would benefit from air-independent propulsion. With AIP it could patrol slowly and quietly for a number of weeks (as compared to a handful of days otherwise) without loud, position-revealing battery-charging evolutions, all the while waiting for a launch order to be delivered via VLF radio broadcast. The submarine's substantial girth and length provide adequate volume for storage of the reagents necessary to support AIP, as well as the space for enhanced quieting measures for other machinery. It is unknown whether China's new submarine has AIP; however, credible reports relate that in March 2011 Islamabad was negotiating with Beijing for the construction of six AIP-equipped submarines, and in 2013 the Department of Defense stated that the Yuan class has AIP. So too could this new submarine.[29]

The overall implication is that the PLA decided some years ago to pursue a concept of operations in which it would deter or destroy hostile surface naval combatants operating in the near seas with large numbers of advanced ASCMs launched from land, aircraft, and surface ships.[30] China's submarine force is now also embracing this mode of operation, though Western navies' submarines have not. The PLAN conventional submarine force, however, is focused on and optimized for a Taiwan contingency and other near-seas missions and hence can pursue a mode of ASUW substantially different from that of most major navies. Equipping the PLAN's conventional attack-submarine force with advanced ASCMs, if supported by robust OTH targeting systems, thus directly supports China's near-seas core interests.

Future Mission: Defend Sea Lines of Communication?

It is generally thought that an emerging and probable future mission for the PLAN is to defend China's sea-lanes against a range of challenges. The lower end of threats to Chinese maritime commerce is perhaps represented by Somali piracy; since 2008, Beijing has deployed two surface combatants and a replenishment ship continuously to the waters near the Horn of Africa as a countermeasure. Yet in the future the PLAN may be called on to guarantee the safe transit of commercial shipping through the Indian Ocean and East Asian waters against the efforts of a modern navy. This mission would require it to protect merchant vessels and surface warships from a diverse array of military threats across the breadth of the Indian Ocean's deep waters, including modern SSNs.

Currently, however, there is little indication that Beijing is preparing for a deepwater ASW mission in any meaningful way. For example, the hull-mounted, medium-frequency sonars of PLAN surface ships are ill suited to open-ocean ASW; only the most modern Chinese destroyers and frigates appear to be capable of deploying towed-array sonars;[31] PLAN aviation's inventory of ASW helicopters is anemic; and only in 2011 did there emerge convincing evidence of even a nascent fixed-wing maritime-patrol-aircraft program.[32] Perhaps most significantly, there are only two second-generation (but still relatively loud, acoustically) Shang-class SSNs in the Chinese fleet, and China's four remaining first-generation SSNs are probably the noisiest nuclear submarines still in commission anywhere in the world.[33] All this means that China's current SSNs are almost certainly incapable of performing effective ASW against their much quieter potential adversaries. The PLAN's diesel submarines cannot conduct effective wide-area ASW either, hampered by their slow speeds and limited endurance. Equally important, China does not possess foreign bases from which it could operate or maintain ASW forces, such as a large fleet of maritime patrol aircraft it could someday develop. It seems likely, then, that the lack of effective expeditionary ASW forces (among other things) will tend to prevent China from conducting high-tempo naval warfare in far seas for quite some time.

Rationally Weak ASW

Still, one can logically wonder *why* China's ASW remains underdeveloped. This is especially perplexing given that the PLA would almost certainly have to expect to confront submarines during military operations in the near seas, especially in a Taiwan scenario. It also seems strange in view of the difficulty of other military challenges China appears to have mastered. Conceivably, Chinese analysts have determined that ASW is simply too hard and too expensive, but this seems unlikely and at odds with the aforementioned recent evidence of expanded ASW efforts. A more plausible explanation for the ASW shortfall could be that the PLA has rationally concluded that it is simply not necessary to find and destroy submarines opposing Chinese military operations against Taiwan or Taipei's potential supporters. China's planners seem to have determined instead that in any of the three plausible operational scenarios involving Taiwan—bombardment, blockade, and invasion—it would be better to avoid and distract, rather than confront and defeat, opposing submarines.

Scenario One: Bombardment

There is little that opposing submarines could do to disrupt or defeat a Chinese air force or Second Artillery Corps ballistic-missile bombardment of Taiwan. Submarines could launch Tomahawk or similar land-attack cruise missiles against airfields or locations assessed as vital for the PLA's short-range ballistic-missile operations, but many of China's air-defense systems, such as the SA-20s obtained from Russia, are designed specifically to shoot down such land-attack weapons. It would be strange too if the number of targets in China did not greatly outnumber the cruise missiles that could be brought by submarine to within firing range.[34] Absent large numbers of submarine-launched missiles that can reliably penetrate Chinese air defenses and a supporting targeting system that can detect fleeting mobile targets and rapidly relay the data underwater, submarines would appear to be essentially irrelevant to mitigating or preventing a Chinese bombardment of Taiwan.[35] Consequently, China does not require, and has not developed, robust ASW to support a bombardment.

Scenario Two: Cruise-Missile Blockade

Precision strikes conducted by the Second Artillery Corps followed up with bombing attacks by PLA air forces have the potential to destroy outright or deny Taiwan the use of its air force and much of its navy.[36] Any Taiwan naval vessels that survived such a bombardment and safely got to sea to oppose a blockade would be subject to antiship-cruise-missile attacks from Beijing's submarines, major surface combatants, and dozens of high-speed Houbei-class YJ-83-carrying, wave-piercing catamarans. These latter vessels, which are optimized for destroying the Taiwan navy and then enforcing a blockade against Taiwan, are by virtue of their high speed, shallow draft, and small size essentially invulnerable to submarines.[37]

Beijing's ASCM-carrying surface combatants, in contrast, are potentially quite vulnerable. However, if PLA submarines are shifting from torpedo-based to ASCM-based ASUW, they would no longer have to lurk near blockaded ports but instead could disperse widely in the shallow, noisy waters to the west and north of Taiwan. Here their mission would be to remain within ASCM range (some two hundred kilometers in the case of the SS-N-27B carried by the Kilo class, for example) of blockaded ports and silently wait for targeting orders to arrive. This mode of blockade by cruise missile would greatly increase the volumes of ocean that would have to be searched for PLAN submarines and the necessary time it would take to localize and destroy them. The poor acoustic conditions of the shallow waters near Taiwan would afford short detection ranges against Chinese submarines, compounding a hunter's challenges.

Another factor degrading the potential ASW performance of submarines is that some waters—this is true of much of the Strait of Taiwan—that are deep enough to permit some conventional submarine and surface-ship operations are simply too shallow for SSNs. Other waters that are sufficiently deep for SSNs are still shallow enough to force them to operate at lower speeds to be sure of their ability to avoid obstacles (including defensively laid Chinese mines).[38]

Short detection ranges and significantly reduced search speeds would greatly extend the time required for predatory submarines to accomplish a mission of PLAN attrition. Individual ASCM-carrying surface ships and submarines would be sunk, but only slowly. Despite tactical successes, dozens of PLAN warships and submarines could survive for extended periods, able to enforce a blockade by shooting long-range ASCMs against commercial and military ships from shallow waters (that are covered by their own shore-based aircraft, surface-to-air, and air-to-air defenses). The net result would be that opposing SSNs would be operationally ineffective, at least for a short-to-medium-length Chinese blockade against Taiwan. This would allow China to achieve a result similar to what it could obtain if it devoted significant effort to ASW, but at significantly less cost and effort.

Scenario Three: Amphibious Assault

As of early 2013, it is not clear that Beijing really views invasion as a viable means of coercing Taipei. Analysts generally agree that the PLAN amphibious force remains too small, and there is scant evidence to show that this shortfall is about to be addressed. If it were, however (and certainly, amphibious ships could be quickly built in large numbers in China's many shipyards), it is unlikely that submarines, considered in isolation, would be an effective counterinvasion mechanism.

The reasons stem from the limited numbers of weapons that submarines can carry, the short ranges at which they could expect to detect and identify amphibious targets, the shallow waters of the operating area (and the slow tactical speeds to which submarines would thereby be restricted), the large number of interfering secondary contacts China could be expected to send across the strait as part of the invasion force (essentially torpedo decoys), and the small number of submarines that could likely be devoted to counterinvasion operations at the expense of other missions (looking for antiship cruise missile–carrying PLAN submarines, escorting carrier strike groups, and so on). One could certainly expect aggressively operated submarines to destroy some Chinese amphibious ships, but anticipated attrition could probably be overcome in advance simply by increasing the size of the invading force.

In sum, then, China appears to have multiple coercive options against Taiwan that sidestep altogether or limit significantly the effectiveness of any opposing submarines. This operational flexibility stems significantly from geography but is greatly enhanced by the PLA's apparent reliance on advanced, long-range antiship cruise missiles and ballistic missiles.

Conclusion

Chinese military strategists appear to recognize that all quiet submarines, whether friendly or hostile, are unlikely to be operationally vulnerable to opposing forces. Beijing's ongoing investment in increasingly modern (and therefore progressively quiet) antiship-cruise-missile-firing diesel submarines reflects a determination to overwhelm and destroy surface ships operating within at least a hundred miles of the shallow waters of the near seas, including Taiwan. This distance is greatly extended and reinforced by the DF-21D antiship ballistic missile and by antiship cruise missiles launched from surface warships and such aircraft as new variants of the H-6 bomber. PLA reliance on large numbers of ASCMs as a means of deterring and defeating opposing surface naval forces represents a significant challenge for a potential adversary, and it suggests specifically that the U.S. Navy's post–Cold War ability to conduct high-volume, uncontested, maritime strike operations from surface warships in the western Pacific has ended, at least temporarily.

On the other hand, Beijing's lack of modern ASW forces—such as maritime patrol aircraft, sub-hunting helicopters, low-frequency surface-ship sonars, and quiet nuclear attack submarines—suggests the PLAN will for some time continue to cede underwater mastery of the deep or distant ocean areas to the West. This may very well suggest a PLA calculated acceptance of losses to opposing SSNs in a Taiwan scenario and a lack of intent to conduct high-tech warfare, at least for the near term, in any distant sea. It would seem, therefore, to be in the military interest of the U.S. Navy to exploit its current underwater advantages. A logical implication could be an expansion of the types and numbers of weapons that could be launched from submarines.

Notes

1. I thank Christopher Weuve, Gordon Willard, Lyle Goldstein, an anonymous reviewer, and other Naval War College colleagues for their insights and other valued contributions to this paper.

2. Orville Schell, quoting State Councilor Dai Bingguo, in "China: Defending Its Core Interest in the World," *Asia Sentinel,* 9 April 2010, www.asiasentinel.com/. See also Michael D. Swaine, "China's Assertive Behavior: Part One: On 'Core Interests,'" *China Leadership Monitor,* no. 34 (2011), available at media.hoover.org/.

3. A carrier air wing's effective range appears to be somewhere between two hundred and four hundred nautical miles. See Angelyn Jewell et al. *USS* Nimitz *and Carrier Airwing Nine Surge Demonstration* (Alexandria, Va.: Center for Naval Analyses, April 1998), p. 32, fig. 10.

4. U.S. Navy Dept., *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics* (Washington, D.C.: Office of Naval Intelligence, August 2009), p. 34.

5. Ibid., p. 40.

6. Regarding the limited number of patrols, see Hans Kristensen, "Feb 03 Chinese Submarine Patrols Doubled in 2008," *Federation of American Scientists,* 3 February 2009, www.fas.org/. Additionally, time spent training at sea in local waters, though not qualifying as "on patrol," can provide substantial training in wartime missions.

7. Slow, diesel submarines firing torpedoes can, however, be highly effective in constrained waters, such as choke points or near harbor entrances through which their prey must pass.

8. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* Annual Report to Congress (Washington, D.C.: Office of the Secretary of Defense, 17 August 2010), p. 48, available at www.defense.gov/.

9. Carlo Kopp, *Soviet/Russian Cruise Missiles,* Technical Report APA-TR-2009-0805 (n.p.: Air Power Australia, updated April 2012), www.ausairpower.net/. See also, for example, *Jane's Naval Weapons Systems,* s.v. "The Klub Family / Klub S Klub N / (91RE2; 91RE1; SS-N-27B [3M54TE; 3M54E]; SS-N-30B [3M14TE; 3M14E]) / Klub K," www.janes.com/, and Carlo Kopp, "Precision Guided Munitions in the Region," *Air Power Australia* (August 2009), www.ausairpower.net/.

10. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* pp. 3, 30.

11. *Jane's Strategic Weapons Systems,* s.v. "C-602 (HN-1/-2/-3/YJ-62/X-600/DH-10/CJ-10/HN-2000)," 1 June 2010, www.janes.com/.

12. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* p. 3; *Jane's Strategic Weapons Systems,* s.v. "C-801 (CSS-N-4 'Sardine' / YJ-1/-8/-81) and C-802 (CSSC-8 'Saccade' / YJ-2/-21/-22/-82/-85), C-803 (YJ-3/-83/-88)," www.janes.com/.

13. A TEL is essentially a truck that can carry and launch a missile. Targeting data for the missiles launched by TELs can be provided remotely from a central headquarters; from predetermined data (for fixed, nonmobile targets) digitally loaded into the missile before launch; or, in some short-range cases against mobile targets (such as ships), from information provided by a radar on or deployed with the TEL.

14. See "YJ-12 Supersonic Anti-ship Missile, Reply #7," ChinaDefense.com, 18 January 2013.

15. Some aircraft, such as the PLA's H-6D/HS-M Badgers, might have the organic radar and horizon height necessary to conduct their own targeting. The author is indebted to an anonymous reviewer for this caveat.

16. See, for example, Ian Easton and Mark A. Stokes, "China's Electronic Intelligence (ELINT) Satellite Developments: Implications for U.S. Air and Naval Operations," *Project 2049 Institute* (23 February 2011), project2049.net/. See also U.S. Defense Dept., *Annual Report to Congress: Military Power of the People's Republic of China, 2009* (Washington, D.C.: 25 March 2009), p. 49, available at sino.defence.com.

17. See Andrew S. Erickson, "China's Anti-ship Ballistic Missile (ASBM) Reaches Equivalent of 'Initial Operational Capability' (IOC): Where It's Going and What It Means," *Andrew S. Erickson: China Analysis from Original Sources* (blog), 12 July 2011, www.andrewerickson.com/, which quotes the 3 January 2011 replies of the Deputy Chief of Naval Operations for Information Dominance (N2/N6), Vice Adm. David J. Dorsett, to questions about China's ability to employ the missile with targeting data derived from satellites, OTH radars, and other sensors.

18. For a description of a buoyant wire antenna, see the brochure "Buoyant Wire Antenna System Submarine Communications," *Lockheed Martin,* www.sippican.com/.

19. The newest variants of the Yuan class seem to have replaced this bell mouth with an antenna, approximately eight feet long, that can be rotated from a horizontal position along the after end of the top of the sail to a vertical position. Such an antenna could probably also receive VLF transmissions while the boat remains fully submerged.

20. This mode of operation is similar to how the U.S. SSBN force trained to execute the Strategic Integrated Operations Plan.

21. SLBMs can be loaded in two large-diameter missile tubes in the after end of the submarine's enormous sail.

22. "PLA Navy Submarine Test-Fires Underwater Missile in Distant Seas," *CCTV-1,* 31 January 2011, Open Source Center, CPP20110131338002.

23. Wu Hanyu, "Analysis of the Key Technologies for the Next-Generation Indigenous Submarine," *Modern Ships* (November 2010), pp. 8–11. I am indebted to Dr. Lyle Goldstein for this translation and citation.

24. Although not guaranteeing accuracy, this does increase the likelihood of the images' being accurate.

25. It is certainly possible that such tubes could also launch land-attack cruise missiles, but there is no credible evidence yet that China is developing a submarine-launched version of such a weapon, whereas there is abundant evidence for new antiship cruise missiles.

26. Wu Hanyu, "Analysis of the Key Technologies for the Next-Generation Indigenous Submarine," pp. 8–11.

27. See "New QING? Class SSB," ChinaDefense.com, post 203, 13 May 2011.

28. See "New QING? Class SSB," ChinaDefense.com, post 254, 27 May 2011.

29. For the negotiations, Jon Grevatt, "Pakistan and China Discuss Submarine Acquisition," *Jane's Defence Industry,* 15 March 2011. For AIP, U.S.

Defense Dept., *Military and Security Developments Involving the People's Republic of China 2013* (Washington, D.C.: Office of the Secretary of Defense, 7 May 2013), p. 7, available at www.defense.gov/.

30. This shift has been reported officially. See U.S. Navy Dept., *People's Liberation Army Navy,* pp. 18–28.

31. See Christopher Carlson, "PLAN Acoustic Decoy and Towed Array Deployment Options," *Clash of Arms,* 20 October 2012, www.clashofarms.com/.

32. See "Y-8GX6 (Y-8Q) ASW Aircraft (High New 6)," ChinaDefense.com, reply 20, 16 November 2011.

33. U.S. Navy Dept., *People's Liberation Army Navy,* p. 22.

34. The U.S. Navy fired over two hundred Tomahawks into Libya during Operation ODYSSEY DAWN. China would presumably present many times more targets for such missiles. See John Reed, "2,000 Tomahawks Fired in Anger," Defensetech.org, 4 August 2011.

35. For a carefully considered alternative view, see Owen R. Coté, Jr., "Submarines in the Air Sea Battle" (paper presented at the 2010 Submarine Technology Symposium, Johns Hopkins University Applied Physics Laboratory, Laurel, Md., 11–13 May 2010), available at web.mit.edu/.

36. See William S. Murray, "Revisiting Taiwan's Defense Strategy," *Naval War College Review* 61, no. 3 (Summer 2008), pp. 13–38.

37. The fifty-knot Houbei would likely run any torpedo to exhaustion. Its aluminum hull would probably not satisfy a torpedo warhead's magnetic arming criteria, and its shallow draft would make a contact detonation very difficult if not impossible. See John Patch's article in this collection.

38. This is because SSNs, which are approximately fifty feet tall from the bottom of their keels to the top of their sails, require vertical operating margins to avoid obstacles (such as merchant ships) on the surface and on the ocean floor.

China's Second Artillery Force

Capabilities and Missions for the Near Seas

Ron Christman

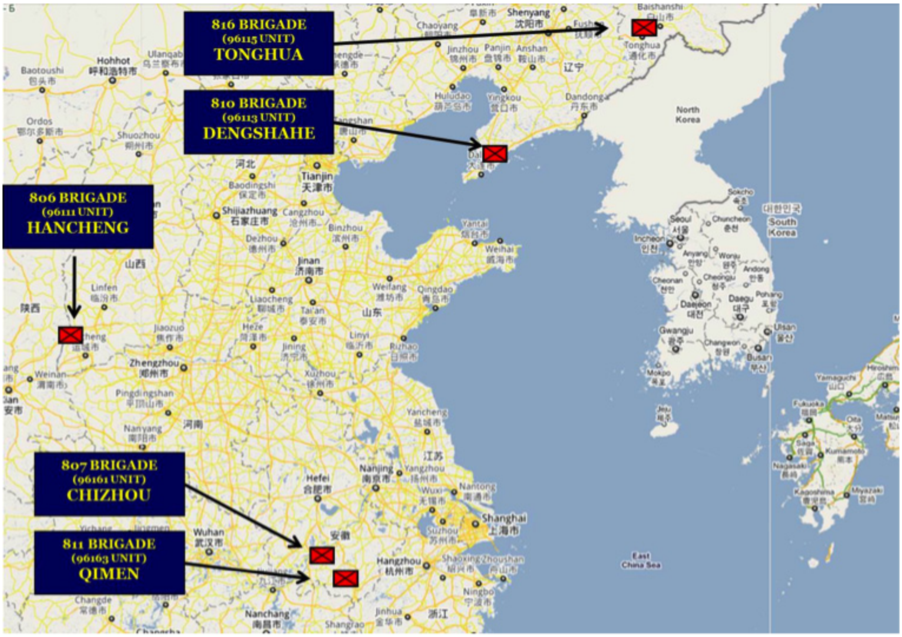
Since its establishment in 1966, the land-based missile force of the Chinese People's Liberation Army (PLA), the Second Artillery Force, has maintained six "basic battle corps" (Bases 51 to 56) at key locations along strategic directions extending outward from China's inland and coastal areas.[1] Three of these combat bases (Bases 51, 52, and 53) are positioned in, respectively, northeast, south-central, and southeast China. These three bases have been responsible traditionally for nuclear missions against land targets of potential adversaries at points on or near the "First Island Chain"—that is, in the near seas.[2]

Beginning in 1994, the Second Artillery Force added a conventional component to its force structure, and most of its conventional units have missions associated with land, and more recently maritime, targets in the near seas. Major milestones in conventional force development include the equipping of at least seven Second Artillery Force or PLA brigades with short-range ballistic missiles and the forming of at least three ground-launched-cruise-missile brigades.[3] More recently, the Second Artillery Force has equipped some of these units with theater ballistic missiles capable of targeting naval ships operating in China's near seas and beyond.[4] Also, a fourth combat base (Base 55), in central China, has equipped one of its brigades in Jiangxi Province with new conventional land-attack, ground-launched cruise missiles appropriate for near-seas missions.[5]

Four of the six Second Artillery Force combat bases now direct seventeen or eighteen known deployed brigades responsible for missions in or immediately beyond the near seas. In effect, two-thirds of the overall Second Artillery Force unit structure is focused on missions associated with the near seas.[6] Other brigades positioned in central or northwestern China are responsible for strategic nuclear deterrence and nuclear counterattack missions or operational/tactical missions employing conventional or nuclear weapons against regional powers. These deployed brigades can be clustered into four force components.

First, a long-standing *theater nuclear force* of at least four brigades is equipped with intermediate-range ballistic missiles or medium-range ballistic missiles armed with single nuclear warheads.[7] These units are subordinate to Base 51 or 52. An additional, Base 53, brigade can be an element of this component, depending on whether it is responsible for a secondary task of holding at risk targets in the near seas in addition to its primary missions against India. A sixth (Base 52) nuclear brigade is a candidate for near-term conversion to a conventional variant of the CSS-5 medium-range ballistic missiles (see figure 1).[8]

Figure 1. *Theater Nuclear Force*



A *conventional tactical-missile force* of at least seven operational brigades is positioned opposite Taiwan and equipped with short-range ballistic missiles.[9] Five of these brigades are commanded by Base 52. Two others are apparently being reassigned from the ground forces to the Second Artillery Force's Base 52.[10] This component can include an eighth brigade, given uncertainty about whether one Base 52 unit is equipped with a new missile system of either short or medium range.[11] See figure 2.

The Second Artillery Force reportedly has formed at least two missiles brigades equipped with *conventional ground-launched cruise missiles* positioned in southern China.[12] Base 53's 821st Brigade is being equipped with ground-launched cruise missiles; it is garrisoned in the Guangxi Zhuang Autonomous Region. Base 55 is also apparently forming a new brigade, the 824th, in Jiangxi Province, reportedly equipped

Figure 2. *Conventional Short-Range-Ballistic-Missile Force*

with ground-launched cruise missiles.[13] Fragmentary reports indicate Base 53 may form a second ground-launched cruise-missile brigade in Yunnan Province, in southwestern China.[14] See figure 3.

Finally, the Second Artillery Force has formed at least one operational brigade positioned in eastern China and equipped with new-type, land-based, *conventional theater ballistic missiles* capable of targeting naval ships operating within or beyond the First Island Chain.[15] The Second Artillery Force is equipping units in eastern China with conventional medium-range ballistic missiles capable of attacking land targets, to include airfields. Base 51's 822nd Brigade is reportedly equipped with new medium-range DF-21D antiship ballistic missiles and DF-21C medium-range ballistic missiles.[16] Base 53 is also forming a new unit, the 825th Brigade, in Guangdong Province at Qingyuan, apparently equipped with either of these systems or newer DF-16 ballistic missiles.[17] Base 52's 811th Brigade is a candidate to convert its medium-range ballistic-missiles inventory from older nuclear to newer conventional CSS-5 variants.[18] See figure 4.

The rough, order-of-magnitude inventory assigned to these four components comprises 1,300–1,800 ballistic or cruise missiles and 300–350 associated transportable or mobile launchers.[19] Fourteen different delivery-system variants are represented in this inventory—four equipped with single nuclear warheads and ten with conventional unitary

Figure 3. *Ground-Launched-Cruise-Missile Force*

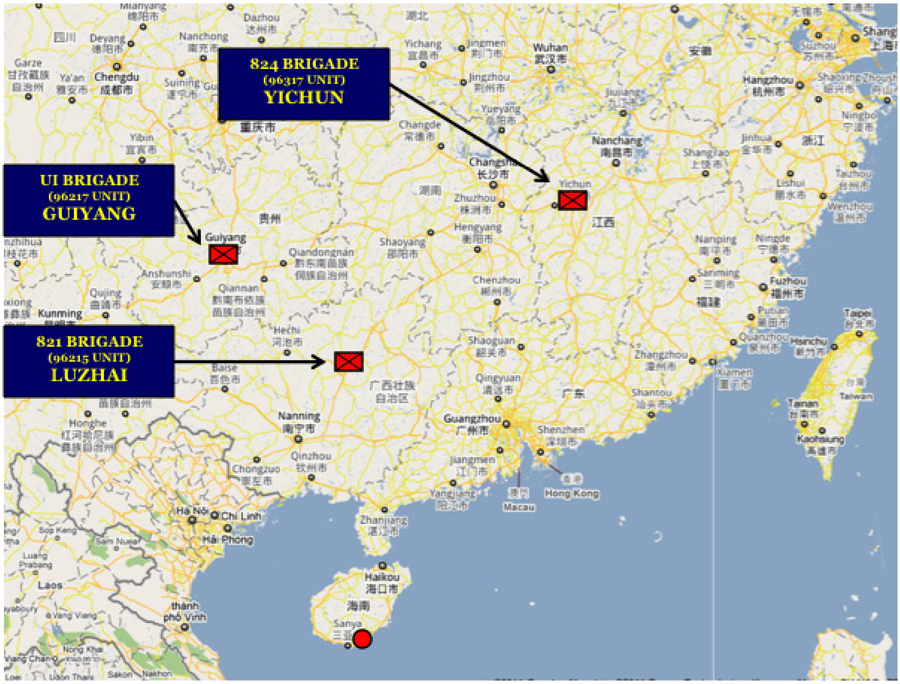
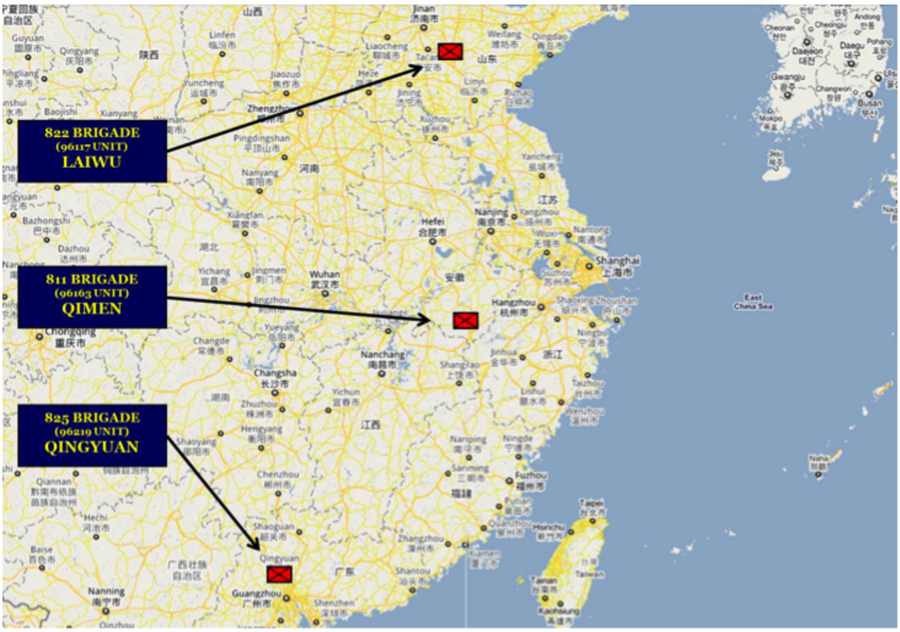


Figure 4. *Conventional MRBM Force*



warheads or optimized submunitions. Thirteen variants are designed to attack land targets, with one newer system variant, the DF-21D antiship ballistic missile, designed to attack naval targets at sea. Each of the four combat bases is equipped with a mix of nuclear and conventional missiles. However, their operational brigades are equipped exclusively with either nuclear or conventional missiles.

Military Capabilities

In crisis or wartime, Second Artillery Force assets with missions in the near seas provide the PLA and senior leaders with formidable military capabilities, whether in terms of their effectiveness in achieving operational objectives, technical performance characteristics, or ability to contribute to broader political objectives.

Theater Nuclear Force Capabilities

China's theater nuclear arsenal enables Beijing to hold at risk civilian or military targets throughout the near-seas areas with nuclear weapons. These missile systems were assigned to Second Artillery Force units in the 1970s or 1980s (CSS-2s) and in the 1990s (nuclear CSS-5s).[20] Potential enemy targets in the near seas would likely be located in South Korea, Japan, and the Philippines.[21]

Liquid-fueled, single-stage CSS-2 intermediate-range ballistic missiles (DF-3s and extended-range DF-3As) are capable of delivering single two-to-three-megaton nuclear warheads to land destinations 2,500 to 2,800 kilometers (km) away with accuracy at the level of a one-to-three-thousand-meter circular error probable (CEP), depending on the variant.[22] Their flight trajectories would be navigated by inertial strap-down guidance, and their prelaunch survivability would be limited by lengthy launch procedures and the presence of large contingents of ground-support vehicles. Nonetheless, CSS-2s are likely to fly depressed trajectories, complicating the problem of enemy ballistic-missile defenses systems that are simultaneously engaging other ballistic missiles with higher reentry angles.

Solid-propelled, two-stage, road-mobile CSS-5 medium-range ballistic missiles (DF-21s) and extended-range DF-21As are capable of delivering single five-to-six-hundred-kiloton nuclear warheads to land destinations 1,700 to 2,700 km away with an accuracy of one to four hundred meters CEP, depending again on the variant.[23] Nuclear CSS-5s would navigate in flight by inertial gyroscope guidance, aided by onboard computers. The system's use of solid-propellant rocket motors probably would enable it to achieve rapid acceleration and high initial speed, thereby reducing its time in the boost phase of flight and thus making it more difficult to shoot down during that period.[24]

China's possession of theater-range nuclear delivery systems provides it a tool for deterring nuclear threat or attack. Given the range of these weapons relative to the distances to key U.S. allies in the near-seas area, Beijing can also rely on those weapons to intimidate these allies in a crisis or war, thereby weakening the credibility of extended deterrence on which those allies may rely—according to Second Artillery commentators (see below).[25] In a 1999 article, Maj. Gen. Lu Haozhong, then president of the Second Artillery Force's Command Institute, asserted that "'attacking strategy' and 'attacking alliances' are an important part of nuclear deterrence."[26] Second Artillery Force thinking on how to attack alliances via deterrence emphasizes tailoring deterrence to the "target," depending on whether alliance partners have differing attitudes toward a war.[27] That is, as one former Second Artillery deputy commander has asserted, if attitudes differ, Chinese deterrence should focus on the dominant country, the one that has the "hard-line attitude." When attitudes in an alliance are the same, "deterrence should be directed first at those countries whose foundation of social and political support is relatively weak."

China's inventory of theater nuclear missiles can play an important role in countering enemy nuclear threats or attacks in near-seas contingencies. They provide potential nuclear options with more credibility than the use of longer-range intercontinental or submarine-launched ballistic missiles against strategic homeland targets of foreign nuclear powers. Should nuclear deterrence fail, these weapons enable China to inflict damage against area targets in the near-seas region, to include population, government, and industrial centers, as well as against soft military targets—including forward U.S. bases and staging areas.

Finally, this theater nuclear force affords China options for implementing the equivalent of American nuclear "flexible deterrent options" (FDOs).[28] The Second Artillery Force intends its nuclear forces to be an active part of China's regional military strategy rather than a passive backdrop to the nation's development of conventional missile forces with antiaccess and area-denial capabilities. The Second Artillery Force views nuclear-force deterrence as an integral factor in conventional missile strike campaigns. This doctrine assumes Chinese missile operations will take place under nuclear deterrence or threat conditions—that is, conventional operations "will necessarily involve the Second Artillery Force nuclear missile unit's deterrence activities."[29]

In a conventional strike campaign, the Second Artillery Force intends to apply the "law of steadily increasing the strength of nuclear deterrence to prepare for the transition" to unlikely but possible nuclear counterattack operations.[30] From the Second Artillery Force's perspective, nuclear missile and warhead units should be the "basic deterrence forces" used to deter nuclear threats or attacks and to contribute to the waging of China's political and diplomatic struggles during a conventional missile strike campaign. See the table.

Second Artillery Force Missile Systems and Their Basic Characteristics

System Type and Designator	Mission	Target	Estimated Range	Payload
DF-3 IRBM	nuclear	land	2,500 km	2–3 mt nuclear
DF-3A IRBM	nuclear	land	2,800 km	2–3 mt nuclear
DF-21 MRBM	nuclear	land	1,700 km	500–600 kt nuclear
DF-21A MRBM	nuclear	land	2,800 km	500–600 kt nuclear
DF-15 SRBM	conventional	land	600 km	HE, armor-piercing, incendiary
Extended-Range DF-15 SRBM	conventional	land	950 km	HE, enhanced-blast, runway-penetrator
DF-15 MaRV SRBM	conventional	land	950 km	multiple unitary warheads and submunitions
DF-11 SRBM	conventional	land	350 km	HE, FAE
DF-11A SRBM	conventional	land	350–530 km	multiple unitary warheads and submunitions
DF-11B SRBM	conventional	land	unknown	unknown
New SR/MRBM	conventional	land	800–1,200 km	enhanced-blast and runway-penetrator
CJ-10 GLCM	conventional	land	1,500+ km	HE (blast)
DF-21C MRBM	conventional	land	1,700 km	HE, armor, FAE, and electromagnetic pulse(?)
DF-21D MRBM	conventional	naval	1,500–2,000 km	antiship

Notes: Chinese-assigned designators.
GLCM = ground-launched cruise missile
IRBM = intermediate-range ballistic missile
kt = kiloton
MaRV = maneuverable reentry vehicle
mt = megaton
SRBM = short-range ballistic missile

Conventional Tactical Missiles

China's tactical missile arsenal of 1,050 to 1,150 CSS-6 and CSS-7 short-range ballistic missiles has been assigned to Second Artillery Force units at different stages since 1993, with most CSS-6 and CSS-7 missiles being distributed to deployed units from 1999 through 2005.[31] On the basis of these units' current disposition and these missiles' assessed ranges, the weapons are capable of attacking targets throughout Taiwan.

The Second Artillery Force is currently equipped with three different solid-propelled, road-mobile, one- or two-stage CSS-6 short-range ballistic-missile variants.[32] The original CSS-6 is capable of delivering a unitary high-explosive (HE) or armor-piercing warhead or incendiary submunitions to a land destination six hundred kilometers away with an accuracy of three to six hundred meters CEP. An extended-range CSS-6 variant can deliver a unitary HE and enhanced-blast warhead or runway-penetrator submunition to a land destination 950 kilometers away with an accuracy of thirty-five to fifty meters CEP. A further CSS-6 variant has the same range as an extended-range CSS-6 variant but would deliver a terminally guided submunition that would maneuver to a land target using sensors, thereby increasing its accuracy to a ten-to-thirty-meter CEP and enhancing its chances of defeating terminal-phase defenses. The first CSS-6 short-range ballistic missile relied on digital and computer-aided inertial guidance, whereas later variants turned to Global Positioning System (GPS), indigenous satellite navigation, or terminal radar, adding fins for in-flight navigation.

The Second Artillery Force is equipped with two versions of the solid-propelled, road-mobile, single-stage CSS-7 short-range ballistic missile, the DF-11 and DF-11A.[33] A third, the DF-11B, may exist, but the evidence is less clear than for the first two. The original CSS-7 missile can deliver a unitary HE or fuel-air explosive (FAE) warhead to a land target 350 km away with an accuracy of five to six hundred meters CEP. The improved DF-11A can deliver a unitary warhead or submunitions to a land target 350 to 530 km away with an accuracy of less than two hundred meters CEP. The original CSS-7's guidance is similar to that of a CSS-6; however, the DF-11A uses combined inertial and satellite (GPS or indigenous) navigation.

According to recent announcements by the government in Taiwan, China has tested and begun deploying a new solid-propelled, road-mobile ballistic missile with assessed ranges of eight hundred to a thousand and a thousand to 1,200 kilometers.[34] It allegedly would be capable of damaging runways or delivering enhanced-blast submunitions against a target. The eight-hundred-to-one-thousand-kilometer-range version of this missile would be capable of hitting targets in the central mountains of Taiwan near east-coast bases, whereas the thousand-to-1,200-kilometer version would have an antiaccess role, according to Tsai Der-Sheng, director of the Taiwan National Security Bureau. Some Taiwan commentators opine that it would be more difficult for Taiwan's PAC-3 (Patriot) units to intercept this longer-range missile than China's other, short-range ballistic missiles, since it would achieve a higher altitude and therefore a higher reentry velocity.[35]

Conventional Land-Attack Ground-Launched Cruise Missiles

Over the last five years, China has enhanced its near-seas ballistic-missile options by establishing the world's largest inventory of extended-range, ground-launched cruise missiles.[36] The Second Artillery Force's cruise-missile brigades are equipped with between two hundred and five hundred Changjian 10 (CJ-10) ground-launched cruise missiles, according to the Department of Defense's report *Military and Security Developments*

Involving the People's Republic of China 2010.[37] These cruise missiles are capable of delivering unitary HE warheads out to a range of 1,500 to two thousand kilometers, with an accuracy of ten meters CEP.[38] This missile relies for guidance on a combination of inertial navigation, GPS, and terrain comparison.[39] CJ-10 missiles can strike from any direction and in a low-altitude trajectory, presenting a challenge for the defender. The CJ-10 would be launched from a three-canister, road-mobile launcher.

Conventional Theater Ballistic Missiles

As stated in the 2010 Defense Department report, "the PLA is acquiring conventional MRBMs [medium-range ballistic missiles] to increase the range at which it can conduct precision strikes against land targets and naval targets, including aircraft carriers, operating far from China's shore out to the first island chain."[40] Over the last six years, the Second Artillery Force has gradually equipped operational brigades with three solid-propelled, road-mobile, two-stage, ballistic-missile variants of the CSS-5 MRBM. China is developing these missiles and other measures to deter or counter intervention by third parties, including the United States, in any cross-strait crisis.[41]

Positioning these missiles in eastern China provides Beijing with military options for striking regional air bases, logistics facilities, and other infrastructure in the near-seas area. The combination of CJ-10 ground-launched cruise missiles and conventional theater ballistic missiles puts at risk all U.S. air bases in South Korea (Osan, Kunsan) and Japan (Kadena, Misawa, and Yokota), as well as alternate staging locations in the area. China's antiship ballistic missiles could also threaten U.S. aircraft carrier strike groups, potentially forcing them to operate at longer ranges from the Chinese coast.[42]

The Second Artillery Force's conventional, road-mobile, theater ballistic missile most likely to be used against enemy air bases would the DF-21C. This MRBM reportedly can deliver unitary HE warheads or various submunitions (armor-penetrating, FAE, and possibly electromagnetic-pulse) to land targets roughly 1,700 km away with a CEP of less than fifty meters.[43] At least one unit, the 822nd Brigade, at Laiwu, in Shandong Province, reportedly is equipped with DF-21Cs. Nongovernmental Western experts have also identified a few other Second Artillery Force brigades as potential candidates for DF-21Cs; however, some are also candidates for DF-21D antiship ballistic missiles or even DF-16s.

China's first-generation, road-mobile DF-21D antiship ballistic missile reportedly would rely on overhead and over-the-horizon sensors to locate and track moving ships, as well as for midcourse and terminal guidance to maneuver a warhead toward an aircraft carrier.[44] It reportedly can deliver a warhead to a naval target as far out as at least 1,650 km. China's English-language *Global Times* recently claimed the nation's first antiship ballistic missile was "deployed with the army."[45] In December 2010, Adm. Robert Willard, then Commander, U.S. Pacific Command, stated in an interview with a Japanese media outlet that the antiship ballistic missile had reached "initial operational capability."[46]

Taiwan's National Security Bureau director recently declared that China has developed and deployed a new ballistic-missile system with short- and medium-range flight capabilities. A third DF-21 conventional variant, the DF-21B, may eventually be deployed in eastern China. However, the only reports of its existence allege that it is deployed in the northwest.[47]

Missions and Scenarios

Most Second Artillery Force planning over the last fifteen years has focused on employing missiles for deterrent, coercive, or war-fighting purposes in a conflict with Taiwan. However, recent friction over territorial disputes in the South China Sea and the Senkaku/Diaoyu Islands and the presence of U.S. naval assets variously in the Yellow Sea and the Sea of Japan raise questions regarding how land-based missiles can be used in those scenarios.

Taiwan Strait Crisis or Conflict Scenarios

The Second Artillery Force's conventional missiles clearly have missions directly relevant to Taiwan Strait scenarios. Two types of missile operations can be employed in crises: missile "deterrence" and the threat or use of missiles in a "surgical strike." The PLA defines "deterrence fire support" as the use of firepower assets, including conventional missiles, in activities designed to "instill fear in our adversary by a show of force or by demonstrating our resolve and readiness to use our fire support forces" in a "war of nerves between the enemy and us."[48] The goal of instilling fear is to "coerce" the adversary into refraining from taking hostile actions or into abandoning its military objectives. Actions the PLA would consider include a show of force—drawing pointed attention to the "physical existence of fire support"—or execution of "a small portion" of fire-support operations, short of full-scale fire-support attacks.[49]

The Second Artillery Force was used on two separate occasions in 1995 and 1996, in show-of-force launches near Taiwan during the run-up to its first presidential election. Such deterrent operations could be initiated again, if cross-strait frictions were renewed. The PLA concept of threatening or using conventional missiles or other firepower assets during local wars in a "surgical strike" as a form of "strategic deterrence" could be applied in a Taiwan Strait contingency.[50] The PLA in its writings points to selective strikes against Taiwan as potential responses to "provocative activities" or "threats" by Taiwan or as a form of firepower support for combat operations designed to seize the offshore islands.[51]

PLA and Second Artillery Force campaign-level doctrine has identified specific wartime missions for the latter relevant to a Taiwan contingency—to include preparatory or direct "fire support" to joint PLA operations and an "independent conventional missile strike campaign" by Second Artillery Force units against key enemy strategic or campaign targets. In a joint PLA campaign, initial operations by other services usually are intended to seize air, sea, ground, and information superiority on the battlefield as a necessary precondition for follow-on operations against specific operational objectives.[52] The PLA and the Second Artillery Force have identified specific fire-support missions and targets for Second Artillery Force operations in support of a wide range of campaigns by the other three PLA services.[53]

Also, an independent conventional Second Artillery Force campaign could be organized to perform a selective "warning strike" against some sensitive target in Taiwan.[54] Potential targets of a selective warning strike include important civilian industrial and nuclear power bases, as well as urban targets, such as political and economic centers. In a war with Taiwan, the Second Artillery Force would also be assigned responsibility for contributing to PLA efforts to deter or counter foreign military intervention, to include American military action to help Taiwan defend itself.

According to the Second Artillery Force's definitive campaign-level doctrinal document, antiship ballistic missiles could be used in five ways against carrier strike groups (CSGs): "firepower harassment strikes" involving direct attack on carrier battle groups; intimidation salvos in front of a CSG, as "a warning shot"; a combination of PLA Navy interception of a CSG and intimidation salvos; the use of penetrating submunitions and concentrated firepower assault to destroy carrier-borne planes or control towers (masts and antennas) and to damage other critical and vulnerable positions; and a disabling electromagnetic attack on a CSG's command-and-control system, including antiradiation or electromagnetic-pulse submunitions against Aegis radars.[55]

Second Artillery Force operations against U.S. air bases could include a combination attack, wherein ballistic-missile attacks would deliver unitary warheads that crater runways and thus fix aircraft in place for destruction (if unsheltered) by follow-on cluster munitions.[56] Cruise missiles can destroy aircraft shelters and damage fuel and maintenance facilities. According to a recent assessment, the Second Artillery Force's current conventional missile inventory is sufficient to close down the five U.S. air bases that are less than 1,100 km from Chinese territory of the six bases in East Asia (Guam being the sixth).[57]

Other Scenarios in the Northern and Southern Near Seas

There is considerably less evidence of a role for the Second Artillery Force in operations designed to defend Chinese sovereignty and territorial integrity at other points on the maritime periphery. China's territorial disputes with its neighbors over the South China Sea and the Senkaku/Diaoyu islands have been lesser contingencies for the PLA compared to the Taiwan scenario over the last fifteen years.

Nonetheless, ongoing efforts by the Second Artillery Force to form new missile units, position them in southeast China, and equip them with new ballistic- or cruise-missile systems are increasing its ability to range major portions of the South China Sea with conventional missile firepower. Additionally, the Second Artillery Force's formation of new units in central and northeast China and its reequipment of existing nuclear units with conventional theater ballistic missiles enhance its ability to engage maritime targets in the Yellow Sea or the disputed Senkaku/Diaoyu area of the East China Sea, as well as land targets in northeast Asia.[58] Recent fragmentary comments by PLA officials and Chinese experts suggest that the PLA and the Second Artillery Force are likely to incorporate conventional missiles into China's courses of action in the northern and southern near seas in the years ahead.

It is important to look back briefly at one of the more obscure reasons why China developed conventional missiles in the 1980s and early 1990s. When China first considered using mobile, solid-fueled missiles to carry conventional warheads, it reportedly initiated a program to develop and field a two-stage, mobile DF-25 missile with a maximum range of 1,700 km. The purpose of the DF-25 would reportedly have been to defend the Spratly/Nansha Islands in the South China Sea.[59] The thinking at the time was that a conventionally tipped ballistic missile, if accurate enough, could provide quick fire support over long distances to PLAN operations in the Spratlys. China did not possess aircraft carriers or air-refueling capabilities at the time; the DF-25 was viewed as compensating for China's inferiority in the air balance. In the late 1980s, Beijing reportedly even ordered an acceleration of the DF-25 program to serve as a stopgap measure until China fielded sea-based naval air and air-refueling capabilities.[60] In the 1990s, the PLA apparently kept alive plans to recapture islands in the Spratly group via amphibious operations, with the DF-25 held in reserve, as a last resort.

We are beginning to see fragmentary signs of assessment by some Chinese officials and experts of the merits of conventional Second Artillery Force missiles in any PLA force package assembled to defend peripheral sea interests in areas other than Taiwan. Commenting on recent press articles about how the Second Artillery Force was establishing new missile bases in southeast China, Shanghai-based military expert Ni Lexiong said in August 2010 that the development "was a hint that the missile force would play a role in defending Beijing's core interest in the South China Sea."[61] During the same month, a Shanghai-based expert on sea power, Mao Yao, argued that one of the first steps China should take in response to tensions with the United States over the South China Sea was to "improve long-range strike systems," including CJ-10 cruise missiles and space-based reconnaissance satellites, "to create a situation in which space power and land power suppress sea power."[62]

A few months earlier, PLA expert Liu Jiangping had sketched out a potential role for Second Artillery Force units in "countermeasures" to protect national security and core interests in response to indications of American and South Korean joint exercises in the Yellow Sea and Sea of Japan and to official U.S. commentary on China's South China Sea claims. According to Liu, the Second Artillery Force could coordinate with PLA Navy operations in the South China Sea or with ground, naval, or air force operations in the Yellow Sea.[63] Depending on the timing of a threat and changes in its severity, "the Second Artillery is the *quickest* in support," compared to other PLA services, and "its missile guidance data can be reloaded in a few minutes." Liu's emphasis on the Second Artillery Force's ability to respond quickly with fire support is the same rationale that was reportedly used to justify a conventional DF-25 role in defending the Nanshas in the 1980s and early 1990s.

These fragmentary indications are not matched by any major increase in indicators that China is carving out a greater Second Artillery Force role in plans for these peripheral sea areas. Nonetheless, the PLA and Second Artillery Force are likely to consider an increased role for the latter in these plans over time. This role is likely to possess the following characteristics.

Small-Scale Operations. A limited expenditure of conventional missile firepower, limited especially in comparison to the requirements of supporting an amphibious landing on Taiwan and follow-on maneuver. In some cases, the Second Artillery Force's role can be restricted to shows of force or selective warning strikes—especially against smaller militaries.

Independent Second Artillery Force Campaigns. Deterrent fire support and surgical strikes in crises in peripheral sea areas, which can be independent operations parallel to any PLA joint or service campaigns.[64] The same logic would apply to selective warning strikes by Second Artillery Force units on sensitive targets in wartime.

Support to Other PLA Services. The Second Artillery Force can support joint or individual PLA service operations to achieve air, ground, naval, and information superiority. On the basis of a review of the PLA National Defense University's 2006 *Science of Campaigns,* the following campaigns can be implemented in peripheral sea area operations other than Taiwan: joint blockade, landing, or anti-air-raid campaigns; PLA Navy "sea-force group"; sea-lane interdiction; offense against coral island reefs; sea-line guarding; naval base defense campaigns; and PLA Air Force air offensive or air defense campaigns.[65]

Concluding Thought: New Ways of Warfare?

Are Second Artillery Force capabilities, such as DF-21D antiship ballistic missiles, enabling new ways of warfare in the near seas and beyond? The answer is clearly yes, in the sense that when the DF-21D antiship ballistic missile achieves full operational capability, an antiship-ballistic-missile capability will have been successfully fielded for the first time by a country's armed forces. Earlier efforts by the Soviet Union and the United States to develop such capability did not yield a deployed weapon system and were halted by the Intermediate-Range Nuclear Forces Treaty.

However, the use of land-based offensive missiles against ships has precedents. Land-based cruise missiles were launched at ships in previous wars, to include two Iraqi Silkworms from a land site in Kuwait against the battleship USS *Missouri* (BB 63) in February 1991, during the first Gulf War.[66] Land-based ballistic missiles have also been fired over water against land targets: Libya fired Soviet-supplied Scud-B short-range ballistic missiles at the Italian island of Lampedusa in 1986.[67]

Nonetheless, China's evolving land-based missile force, missions, and capabilities for the near seas pose important challenges for American and allied defense postures and military capabilities, at all levels of warfare. Operationally, the Second Artillery Force's expanding and modernizing capability against potential land and maritime targets in the near seas reinforces the insightful observation of Wayne Hughes that the offense, defense, and "staying power" of a ship or force all need to be evaluated together in estimating combat power in a new tactical era characterized by missile warfare.[68]

The Second Artillery Force has established a sophisticated operational strategy to ensure that its deployed units survive in combat. This strategy relies on "maneuvering operations" between fixed operational and support positions as the chief pattern for operational deployment and on "mobile operations" as the main combat mode. In combat, Second Artillery Force operational units will rely on a satellite warning system to exploit gaps in enemy reconnaissance; operate at night and in adverse weather or low-light conditions; maintain a quick operating tempo when preparing to launch or redeploying postlaunch; and utilize multiple field operating areas and widely dispersed positions. Tactically, enhancements to land-based missiles are creating opportunities for China to combine several different tactics and technical capabilities in more effective attacks against defended targets. Operational counter-countermeasures to ballistic-missile or air defenses are likely, in addition to various technical penetration aids frequently discussed by Chinese analysts assessing China's ability to defeat missile defenses.

To look forward, American and allied missile and air-defense operators and systems are likely to have to cope with many forms of structured attacks, such as timed arrivals and salvo launches; wide-azimuth attacks; shaped trajectories; mixed unitary and submunition payloads; coordinated ballistic- and cruise-missile launches; antiradiation homing missiles; electronic attack measures by other PLA services to enable Second Artillery Force missiles to penetrate defenses; PLA special-operations actions against ground-based missile-defense radars, command vehicles, and crews; and, eventually, multiple missiles launched against moving targets, including ships. Enemy forces and ships operating in the area, local installations or infrastructures, and critical network nodes are very likely to be hit. This vulnerability to China's land-based missile power reinforces for its potential adversaries the importance of developing and operating forces and systems able to absorb damage and continue fighting.

Finally, the continued existence of a theater-nuclear-force component of China's missile posture for the near seas and the integral role of nuclear FDOs in the Second Artillery Force's conventional missile campaign doctrine raise important questions regarding the cost and risk Beijing would be willing to incur in prosecuting military operations at various points in the near seas. Definitive Second Artillery Force doctrine calls for nuclear deterrence activities (signaling, etc.) in parallel with conventional missile campaigns. The extent to which senior Chinese civilian leaders are aware of or endorse the nuclear dimension of Second Artillery Force conventional missile campaign planning is unknown.

In any event, actual implementation by the Second Artillery Force of these nuclear FDOs could create conditions for escalation of a conventional war, even if they are designed merely to "check" enemy nuclear intimidation without resorting to first use of nuclear weapons. China's adversaries could misinterpret nuclear-deterrent actions as the generation of nuclear forces to a state of combat readiness and take corresponding countermeasures. These Second Artillery Force concepts highlight the unintentional risks and costs possibly associated with countering China's antiaccess and area-denial strategy in the western Pacific.

Enemy operations against land-based Chinese missile forces probably would occur as the Second Artillery Force's nuclear deterrence activities were going forward. Indications of Chinese nuclear activities would telegraph to adversaries the risks associated with counter–missile forces operations against Second Artillery Force units in mainland China. Should these indications result in enemy restraint in targeting missile units, Second Artillery Force units would operate in conditions of virtual sanctuary, thereby enhancing China's leverage. Conversely, however, if its enemies "fight through" China's nuclear deterrence, follow-on Second Artillery Force operations would be complicated. China would be confronted with a choice between escalating its mode of nuclear signaling and confining its missile operations to conventional means of war.

Notes

1. "Second Artillery Force," sec. 4 of *Fundamental Artillery Tactics* (Changsha, PRC: National Defense Technology Univ., February 2001), p. 295.
2. James C. Mulvenon and Andrew N. D. Yang, *The People's Liberation Army as Organization,* reference volume 1.0 (Santa Monica: RAND, 2002), pp. 530–36.
3. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* Annual Report to Congress (Washington, D.C.: 17 August 2010), p. 66, available at www.defense.gov/. See also the data sheet "DongHai 10 (ChangJian 10) Land-Attack Cruise Missile," *China's Defence Today,* updated 3 October 2009, www.sinodefence.com/.
4. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* p. 2.
5. Mark A. Stokes and Ian Easton, "Evolving Aerospace Trends in the Asia-Pacific Region: Implications for Stability in the Taiwan Strait and Beyond," *Project 2049 Institute* (27 May 2010), p. 15, project2049.net/.
6. Ibid., pp. 80–91.
7. The four brigades in this component are the 806th, 810th, and 816th Brigades of the 51st Base and the 807th Brigade of the 52nd Base. Ibid.
8. Ibid., pp. 13–14.
9. U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* p. 66.
10. See the last section of Mark Stokes, "Expansion of China's Ballistic Missile Infrastructure Opposite Taiwan," *AsiaEye* (blog), blog.project2049.net/.
11. Ibid.
12. Stokes and Easton, "Evolving Aerospace Trends in the Asia-Pacific Region," pp. 14–15.
13. Ian Easton, "The Assassin under the Radar: China's DH-10 Cruise Missile Program," *Project 2049 Institute,* Futuregram 09-005 (1 October 2009), p. 4, project2049.net/.
14. "Donghai 10 Land-Attack Cruise Missile," *China's Defence Today*, www.sinodefence.com/.
15. Mark Stokes, "China's Evolving Conventional Strategic Strike Capability: The Anti-ship Ballistic Missile Challenge to U.S. Maritime Operations in the Western Pacific and Beyond," *Project 2049 Institute* (14 September 2009), project2049.net/.
16. For more on these units see Stokes and Easton, "Evolving Aerospace Trends in the Asia-Pacific Region," pp. 12–15.
17. The formation of this unit and its likely weapon system have been reported in a recent Project 2049 blog posting as Unit 96219 of the 53rd Second Artillery Force Base; Stokes, "Expansion of China's Ballistic Missile Infrastructure Opposite Taiwan." Taiwan's National Security Bureau director, Tsai Der-Sheng, told Taiwan's legislature in mid-March 2011 that China was deploying a new ballistic-missile system designated the DF-16, with a range of eight hundred to a thousand kilometers, or more; Wendell Minnick, "China Ramps Up Missile Threat with DF-16," *Defense News,* 21 March 2011.
18. Stokes and Easton, "Evolving Aerospace Trends in the Asia-Pacific Region," p. 13.
19. See U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* p. 66, table.
20. See the data sheets "Dong Feng 3 (CSS-2) Intermediate-Range Ballistic Missile" [updated 27 February 2009] and "Dong Feng 21 (CSS-5) Medium-Range Ballistic Missile" [updated 4 June 2010], *China's Defence Today,* www.sinodefence.com/.
21. John Wilson Lewis and Hua Di, "China's Ballistic Missile Programs: Technologies, Strategies, Goals," *International Security* 17, no. 2 (Fall 1992).
22. "Dong Feng 3 (CSS-2) Intermediate-Range Ballistic Missile."
23. "Dong Feng 21 (CSS-5) Medium-Range Ballistic Missile."
24. Clayton K. S. Chun, "Ballistic Missile Fundamentals: How Ballistic Missiles Work," chap. 1 in *Thunder over the Horizon: From V-2 Rockets to Ballistic Missiles* (Santa Barbara, Calif.: Praeger, 2006), p. 15.
25. For an earlier reference to China's intent to "decouple" the United States from its allies in the region, especially Japan and South Korea, "by using the threat of theater nuclear weapons," see page 41 in Bates Gill and James Mulvenon, "The Chinese Strategic Rocket Forces: Transition to Credible Deterrence," in *China and Weapons of Mass Destruction: Implications for the United States,* Conference Report CR-99-05 (Washington, D.C.: Congressional Research Service and National Intelligence Council, April 2000). The conference was held in Washington, D.C., 5 November 1999.

26. Maj. Gen. Lu Haozhong and Senior Col. Zhang Jinxi, "Contemporary Strategy of Nuclear Deterrence" [in Chinese], *Zhongguo Junshi Kexue* (Beijing), 20 May 1999, Foreign Broadcast Information Service [hereafter FBIS] CPP20010206000162.
27. Lt. Gen. Zhao Xijun, "'Victory without War' and Modern Deterrence Strategy" [in Chinese], *Zhongguo Junshi Kexue* (Beijing), 31 October 2001, pp. 55–60, FBIS CPP2011228000132. Lieutenant General Zhao was then deputy commander of the Second Artillery.
28. FDOs, in U.S. military lexicon, are "planning construct[s] . . . that begin with deterrent-oriented actions carefully tailored to produce a desired effect." U.S. Defense Dept., *Department of Defense Dictionary of Military and Associated Terms,* Joint Publication 1-02 (Washington, D.C.: 8 November 2010), s.v. "Flexible Deterrent Options," available at www.dtic.mil/.
29. Yu Jixun, ed., *The Science of Second Artillery Campaigns* (Beijing: People's Liberation Army Press for the People's Liberation Army Second Artillery Corps, March 2004), p. 127.
30. Ibid., p. 232, for both this quoted phrase and the next.
31. For arsenal size, U.S. Defense Dept., *Military and Security Developments Involving the People's Republic of China 2010,* p. 2.
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CHAPTER FOUR

Aerospace Power and China's Counterstrike Doctrine in the Near Seas

Daniel J. Kostecka

> *In order to defend the security of the national territory, marine territories and the waters within the First Island Chain, this proactive defense strategy does not mean that our navy only stays within the First Island Chain.*
>
> REAR ADM. ZHANG ZHAOZHANG, APRIL 2009

The aim of this chapter is to examine recent developments in China's ability to use the key constituents of aerospace power—aircraft and conventional missiles—to achieve strategic objectives in the near seas.[1] The chapter will discuss aerospace power in the context of China's maritime defense strategy, including its historical foundations; analyze China's current doctrine for use of aerospace power in the near seas; and consider recent advances in Chinese aircraft and conventional missile capabilities as they pertain to this doctrine. This chapter does not address all aspects of China's aerospace capabilities that are necessary for dominance in the near seas. Instead, it analyzes some of the more visible and higher-profile aspects of China's growing capabilities necessary for defending China's expanding maritime strategic depth.

Aerospace Power and Coastal Defense

Aerospace power has been fundamental for defending the near seas of the People's Republic of China (PRC) since its founding.[2] While air and naval operations did not play significant roles in the Chinese Civil War, immediately thereafter the victorious forces were threatened by hostile air and naval forces from the maritime sphere. In 1949 the regime was ill equipped to defend its eleven thousand miles of coastline and more than six thousand islands against attack and harassment from Nationalist Chinese air and naval forces, let alone protect the PRC against the aircraft carriers of the powerful U.S. Seventh Fleet. Even before the founding of the People's Republic, its future leaders recognized the need for strong naval and air forces.[3] This need soon became apparent, when in June 1949 the Kuomintang (KMT) government on Taiwan declared a blockade of coastal mainland ports and KMT naval and air forces began attacking coastal shipping and ports, as well as laying mines in river estuaries.[4]

Over the course of the 1950s the PLA experienced mixed success in protecting China's coastline. In 1949, communist forces captured Hainan Island, the second-largest KMT-held island; most of the smaller offshore islands fell in the early 1950s. The People's Liberation Army (PLA) was successful too in stopping KMT raids on the mainland and on merchant and fishing fleets. However, KMT forces stubbornly held Jinmen and Matsu, as well as a few additional islands, such as Taiping (Itu Aba) in the South China Sea, and in this period the PLA was never a serious threat to invade Taiwan. Throughout the 1950s, PLA naval and air forces were impotent against powerful U.S. elements operating in China's near seas, as evidenced by the Seventh Fleet's role in resupplying Jinmen in 1954–55 and in evacuating KMT troops and civilians from the Dachen Islands in 1955, as well as in escorting KMT vessels resupplying Nationalist-held offshore islands in 1958.[5]

Despite a clear need to defend China's near seas, resource constraints meant that coastal defense represented the extent of the operational capabilities of the PLA's sea and air forces. The overall focus of the PLA Navy (PLAN) on coastal-defense versus longer-range operations is evidenced by the deployment of thirteen coastal-defense artillery regiments in 1951, the primary focus of naval aviation on air- and ground-based defense of fleet bases, and the disbanding of the PLAN marines in 1957, only three years after the force was established.[6] While PLAN aviation and aircraft of the PLA Air Force (PLAAF) flew several hundred sorties during campaigns of the 1950s, they were primarily relegated to coastal air defense, under strict rules of engagement. On a positive note, the 1950s ended with the KMT air force no longer operating at will over Fujian and Guangdong Provinces, thanks to a permanent presence of PLAAF and PLAN aviation along China's eastern and southern coastlines.[7] Overall, though, while China's air forces demonstrated the capacity to defend the nation's airspace against KMT aircraft, they could do little to counter American air and naval operations in the near seas, as demonstrated by the Seventh Fleet's operations in and around the Taiwan Strait in the 1950s and the free-wheeling nature of U.S. Navy and Air Force air support to United Nations forces during the Korean War.[8]

Throughout the 1960s and 1970s PLA air forces continued to emphasize coastal air defense and possessed little ability to exert influence in China's near seas. The KMT air force on Taiwan continued to fly reconnaissance aircraft over the mainland; several of these were shot down, and PLAN fighters based on Hainan shot down a small number of U.S. Navy and Air Force fighters that strayed too close to Chinese airspace during the Vietnam War.[9] Nevertheless, some combat operations by the PLA in the 1970s called on China's air forces to push beyond the coastal-defense paradigm. In 1974, PLAN fighter aircraft flew thirty-eight sorties in support of operations to seize the Paracel Islands from South Vietnam, a mission that to this day represents the longest-distance opposed landing operation executed by the PLA. Further, in the 1979 border conflict with Vietnam, PLAN aircraft flew 751 sorties in support of fleet units operating off Vietnam's coast (no information is available regarding the types of missions flown).[10]

Development of the Near Seas Defense Strategy

The need for China's air forces to push their operations farther out over water gained urgency in the 1980s as China's naval strategy changed under the leadership of a dynamic new PLAN commander. Building on developments of the 1970s, in 1982, Adm. Liu Huaqing directed the Naval Research Institute to develop a regional naval strategy, which would become known as "Near Seas Defense" (or, more commonly, "offshore defense"), that would move the PLAN beyond the coastal-defense paradigm.[11] Like all PLAN commanders prior to 1996, Admiral Liu had been originally an army officer; however, in a military often dominated by the "great infantry" concept, he was more than just an infantryman serving in a naval billet. Liu proved to be an aggressive and forward-thinking maritime strategist, and by developing the strategy of Near Seas Defense and pushing for continued modernization, he laid many of the intellectual and technical foundations of the PLAN of the early twenty-first century.[12]

While Near Seas Defense is defined a variety of ways and is often generically associated with operations within China's two-hundred-nautical-mile exclusive economic zone, Admiral Liu himself defined Near Seas Defense as operations within and outside the "First Island Chain," running from Japan to Taiwan and the Philippines. Liu defined Near Seas Defense as a regional strategy specific to China's maritime claims and interests; he did not advocate replicating American or Soviet global naval capabilities. Instead, he made comparisons to the 1980s-era naval strategies of Great Britain, France, Germany, Italy, and Japan.[13]

It is noteworthy that Liu's articulation of offshore defense is far closer to what Alfred Thayer Mahan advocated for the United States than most realize. U.S. Naval War College scholars James Holmes and Toshi Yoshihara state, "Close study will reveal that Mahan never counseled naval war for its own sake. Far from espousing an open-ended American naval buildup, he urged the U.S. Navy to assume the strategic defensive in vital waters, chiefly the Caribbean Sea and the Gulf of Mexico, expanses that would provide America its 'gateway to the Pacific' once the Panama Canal opened."[14]

Just as Mahan argued that the control of the Caribbean Sea and Gulf of Mexico was essential to promoting American development and defending maritime commerce and that the Caribbean Sea was the strategic key to America's maritime frontiers on the Atlantic and Pacific Oceans, Liu held out the Yellow, East China, and South China Seas as troves of resources and protective screens for China's own development.[15] Where Mahan viewed such key geographic points as Cuba and Jamaica as essential for controlling access to the Caribbean and thus the soon-to-be-completed Panama Canal, offshore defense is concerned with the Spratly Islands in the South China Sea because of their location along strategic sea-lanes linking China to the Pacific and Indian Oceans, as well as their overall importance in protecting the South China Sea, which Liu designated "the southern gate of our motherland."[16] Additionally, while Liu wrote about Taiwan in regard to the need to reunify it with the homeland, subsequent Chinese strategists have discussed Taiwan much as Mahan discussed islands like Cuba, Jamaica, and Hawaii and their importance to the United States as keys to controlling maritime communications and protecting maritime interests, or, if in the hands of foreign power, as barriers threatening trade and development.[17]

However, for all his strategic vision, Admiral Liu developed China's naval strategy in a time far removed from that of Mahan, and he had to contend with something Mahan did not—the dominance of airpower in the maritime battle space. When the strategy of Near Seas Defense was first put in place in 1986, the PLAN's lack of credible air defense for its surface ships and the obsolescence and short range of the fighter aircraft equipping both the PLAAF and PLAN meant that little could be done to protect China's near seas against a serious opponent.[18] Beyond that, a lack of long-range precision-strike (LRPS) capability on the parts of the PLAN and PLAAF, as well as China's missile force, the Second Artillery Force, meant that the PLA could do little in terms of offensive operations against an enemy's air and naval forces during a conflict on the maritime periphery.

As the 1980s gave way to the 1990s, however, the need for the PLAN to be able to execute a near-seas defensive strategy became crystal clear. The collapse of the Soviet Union eliminated a large-scale threat that the Central Military Commission even in 1985 had correctly recognized was diminishing. Operation DESERT STORM and subsequent U.S.-led operations against Iraq and in the Balkans throughout the 1990s demonstrated the effectiveness of LRPS technology. It became clear to PRC leaders that an enemy equipped with LRPS weaponry could launch it against China's densely populated and economically vibrant coastal provinces from air- and sea-based platforms outside the range of China's defenses. Further, the Taiwan Strait crisis of 1996, during which the United States deployed two aircraft carrier groups in the vicinity of Taiwan as a show of support against PRC missile drills intended to intimidate the island during its first democratic elections, served as a harsh lesson to China's leaders regarding its vulnerability to an enemy with a first-class military.[19]

A Counterstrike Doctrine for Near-Seas Defense

In terms of potential conflicts in China's near seas, a Taiwan contingency is the foremost issue on the minds of many strategists on both sides of the Pacific Ocean. While China has developed the capability to conduct robust firepower strikes and blockades against Taiwan, at this time the PLA does not possess the ability to invade it. Therefore, in a time of crisis, China's overall goal is to deter Taiwan from moving toward a formal declaration of independence while possessing the capability to punish Taiwan severely should it do so anyway and to prevent the United States from intervening on its behalf, by threatening U.S. forces and bases throughout the western Pacific.[20] However, by focusing on the development of multimission platforms and weapons that could execute large-scale coercive and punishment operations against Taiwan, the PLA as a whole is quietly evolving into a balanced and flexible force capable of conducting missions across the spectrum of military operations, including such nonwar operations as the ongoing counterpiracy deployment to the Gulf of Aden and the use of PLAN and PLAAF assets to evacuate Chinese citizens from Libya in 2011. Additionally, the counterstrike capabilities the PLA is developing to deter or defeat American intervention in a Taiwan scenario are just as applicable for countering U.S. intervention in other contingencies in China's near seas. Late 2010 statements by high-level American officials regarding U.S. interests in the South and East China Seas and inflammatory Chinese rhetoric over the possible participation of the aircraft carrier USS *George Washington* (CVN 73) in exercises in the Yellow Sea highlight potential areas of tension between Beijing and Washington in the western Pacific.[21]

The operational conceptual element of this emerging counterstrike doctrine is known as "noncontact warfare." While sometimes incorrectly characterized as a "Sun Tzu–esque" method of winning without fighting, noncontact warfare is in fact nothing more than the employment of long-range precision-strike systems from outside an enemy's defended zone against key nodes throughout the strategic and operational depths of an enemy's "system" (see below).[22] *Science of Military Strategy* (2005) discusses at length the need to conduct nonlinear standoff attacks against key points and centers of gravity across the breadth and depth of an enemy's system. Primary targets include command-and-control systems and logistics facilities. In fact, *Science of Military Strategy* argues that an enemy's primary combat forces should be attacked only after the destruction of information and logistics capabilities, because the combat capabilities of the main operational forces will thus be significantly weakened. The goal is not the wholesale destruction of an enemy but the paralysis of its combat forces by robbing them of essential information and supplies. Analogies are drawn to the destruction of a body's brain and central nervous system.[23]

For American planners, the relevant aspect in this line of thought is that in a conflict between the United States and China in East Asia, the first American targets the PLA would go after might not be carrier strike groups or the runways and parking aprons at Kadena Air Base on Okinawa. Instead, the PLA might single out the replenishment vessels that supply the strike groups at sea, as well as land-based logistics and command-and-control targets. A December 2005 article in the PLAN newspaper 人民海军 (People's Navy) discusses the need for constant at-sea replenishment as one of the primary weaknesses of U.S. carrier strike groups.[24] With regard to broader counterstrike operations, the air bases that receive the most attention from the PLA in the early stages of a conflict are likely to be those where the United States bases airborne tankers and command-and-control aircraft and similarly high-value assets.

It is noteworthy that the PLA's counterstrike doctrine is not particularly new. Airpower theorists have been claiming since the 1920s that strategic strikes against key targets can paralyze an enemy's war effort. In fact, the best articulation of how the PLA defines its counterstrike doctrine can be found not in any book or article in Chinese but in an article entitled "The Enemy as a System," by Col. John Warden of the U.S. Air Force (now retired) in the Spring 1995 edition of *Airpower Journal*. Warden, one of the architects of the U.S.-led coalition air campaign in DESERT STORM, represents potential enemies as a five-ring model, the rings representing, from the inside out, "Leadership," "Organic Essentials" (such as electricity), "Key Infrastructure," "Population," and "Fielded Forces." In terms similar to those used now by the Chinese, Warden describes a properly executed air campaign as one of nonlinear attacks against key targets to induce strategic and operational paralysis, thereby making engagement of an enemy's military forces either unnecessary or the result of which at least virtually a foregone conclusion.[25] Not surprisingly, Warden's views on airpower are known to the Chinese. Noted PLAAF general and military commentator Liu Yazhou calls Warden the "[Giulio] Douhet of our time," while the five-ring model receives prominent mention in the 2002 book *Air Raid and Anti–Air Raid in the 21st Century*.[26]

The notion of forcing strategic and operational paralysis on an enemy through long-range precision air and missile strikes is controversial, to say the least, and the issue will not be debated in these pages. For now it is sufficient to say that the PLA has developed and is refining a counterstrike doctrine based on classic airpower theory and applied with a growing array of precision-strike weapons. Operationally, this doctrine flows from the strategic framework articulated in *Science of Military Strategy*. Further, *Air Raid and Anti–Air Raid* calls for organizing counterstrike forces under the command of a "Counterattack Operations Group." The forces assigned to or at least coordinated by this group include the fighter and attack aviation of the PLAAF and PLAN, conventional ballistic- and cruise-missile units, attack helicopters, surface ships, submarines, and special operations forces.[27] Key targets include command-and-control systems, logistics, air bases, aircraft carriers, and missile launchers. For aerospace forces, *Air Raid and Anti–Air Raid,* the 2004 *Study on Joint Firepower Warfare Theory,* and the 2006 *Science of Campaigns* detail missile and air counterattack operations against command-and-control systems, air bases, air defenses, and logistics facilities, with an emphasis on large, fixed targets. Command-and-control systems are specifically called out as important targets for missile and air strikes, by virtue of their functions as nerve centers and force multipliers. When coordinated strikes are not possible owing to enemy aircraft carriers and air forces operating out of range of the PLA's own air forces, as the book *Science of Second Artillery Campaigns* highlights, long-range conventional missiles in strikes against enemy bases and carrier groups are important.[28]

The Modernization of the PLA's Counterstrike Air and Missile Forces

To defend China's near seas and execute the PLA's ambitious counterstrike doctrine, the PLA has over the past two decades invested a great deal in modernizing the counterstrike capabilities of the PLAN, the PLAAF, and the Second Artillery Force. The result has been the fielding of an impressive array of short- and medium-range conventional ballistic missiles and of ground- and air-launched cruise missiles; a variety of precision-guided land-attack munitions and the combat aircraft necessary to employ them; and highly capable antiship cruise missiles that can be fired from surface ships, submarines, maritime strike aircraft, and shore-based launchers. As part of this modernization program, the Second Artillery Force is also in the process of fielding the DF-21D (based on the CSS-5 airframe), a medium-range ballistic missile specifically designed to target U.S. aircraft carriers at sea.[29] While across the board the PLA is not as capable as the U.S. military, the PLA's concentration on the development of specific counterstrike capabilities enables it to develop pockets of excellence in such areas as conventional ballistic missiles, submarines, antiship cruise missiles, and electronic warfare. This allows it to threaten opposing forces in the western Pacific with a high-risk calculus in times of tension or war, particularly as those forces approach China's near seas.[30]

For counterstrike aviation forces in the PLAN, the past decade has seen PLAN aviation transition from an air force primarily concerned with coastal air defense to a modern offensive maritime strike force. In the 1990s the PLAN took delivery of a small number of early models of the J-8II interceptor and JH-7 maritime strike aircraft; today, through acquisition of new blocks of these airframes and upgrades to older systems, the PLAN fields five regiments of the JH-7/JH-7A and two regiments of the J-8II. The PLAN also operates one regiment of Russian-built Su-30MK2 Flanker multirole maritime strike fighters; since late 2010 it has taken delivery of the indigenous, fourth-generation J-11B Flanker and J-10 interceptors.[31] The JH-7/JH-7A is the PLAN's workhorse maritime strike fighter and has evolved into a highly capable two-seat maritime strike fighter able to employ the YJ-83K antiship cruise missile and advanced electronic warfare systems. Complementing the JH-7/JH-7A units, the single Su-30MK2 regiment can employ antiship and antiradiation variants of the Russian-made Kh-31.[32] The J-8II, while based on an older-generation design, has radar and avionics upgrades that enable it now to employ modern beyond-visual-range air-to-air missiles; its range can be extended through refueling from the PLAN's small inventory of H-6 tanker aircraft.[33] The J-11B and J-10 combine with the Su-30MK2s to provide the PLAN with the ability to extend air defenses to PLAN task groups beyond China's coastal waters.

Complementing the PLAN's inventory of fighters and strike fighters are two regiments of H-6 maritime strike bombers, based on the 1950s-era Soviet Tu-16 but upgraded to employ modern antiship cruise missiles. There is also a single regiment of J-7E short-range interceptors.[34] While not a global expeditionary force, PLAN strike aviation is a modern regional one, capable of covering from its bases on the Chinese mainland the near-seas defense areas defined by Liu Huaqing as extending beyond the First Island Chain.[35]

The Second Artillery Force is arguably the primary arm of the PLA tasked with counterstrike operations in China's near seas. The 2008 white paper on China's national defense states, "The conventional missile force of the Second Artillery Force is charged mainly with the task of conducting medium- and long-range precision strikes against key strategic and operational targets of the enemy."[36] According to the U.S. Department of Defense, as of late 2009 the Second Artillery had deployed over a thousand CSS-6 (six-hundred-kilometer range) and CSS-7 short-range (three hundred kilometers [km]) ballistic missiles within reach of Taiwan, including a growing number with precision-strike capability. Additionally, the Second Artillery reportedly possesses up to a hundred CSS-5 medium-range (1,750 km) ballistic missiles—their numbers are increasing—as well as up to five hundred DH-10 ground-launched cruise missiles (1,500 km). While the shorter-range ballistic missiles can hit only a limited target set beyond Taiwan, the growing numbers of conventionally armed and precision-strike-capable CSS-5s and DH-10s demonstrate the PLA's desire to be able to extend its counterstrike options throughout China's near seas.[37] In addition to conventional precision strikes against land targets, the Second Artillery, owing to the development of the DF-21D, now has a maritime mission against U.S. carrier strike groups. This system, under development for several years, is now operational, according to Adm. Robert F. Willard, Commander, U.S. Pacific Command.[38] In fact, a role for the Second Artillery in maritime strike operations was documented in the PLA's counterstrike doctrine about a decade ago: *Air Raid and Anti–Air Raid* discusses the use of ballistic missiles in "surprise attacks at sea."[39] *Study on Joint Firepower Warfare Theory* states that land-based missile and naval forces should integrate high- and low-altitude missile attacks against aircraft carriers at sea and calls for attacking aircraft carriers in port.[40]

In addition to PLAN aviation and the Second Artillery, the PLAAF also plays an important role in counterstrike operations in the near seas. Over the past decade the PLAAF has grown from a force primarily concerned with short-range air defense of its homeland to one capable of extending China's air-defense envelope out over the water and increasingly able to conduct long-range precision-strike missions.[41] A growing portion of the PLAAF comprises modern fighter aircraft, such as the imported Su-27 Flanker and indigenous fighters like the J-11B Flanker, the J-10, and upgraded variants of the J-8II. Additionally, the PLAAF employs the multirole Su-30MKK Flanker imported from Russia, as well as several regiments of the JH-7A strike fighters, equipped with the KD-88 land-attack cruise missile.[42] Aside from its growing inventory of fighters and strike fighters capable of extended operations over China's near seas, the PLAAF is upgrading its inventory of H-6 bombers to employ the YJ-63 and DH-10 land-attack cruise missiles. A significant element of this effort is the development of the H-6K, a new extended-range variant of the H-6 that, with the long-range DH-10, can threaten American bases, such as Guam, in the "Second Island Chain."[43] As the PLAAF's inventory of long-range aircraft armed with long-range standoff missiles grows, its capacity to expand the counterstrike envelope of China's Near Seas Defense strategy will grow as well.

Carrier Aviation

Another key element of China's maritime aerospace power trajectory is the PLAN's aircraft carrier program. In August 2012 the PLAN commissioned, as *Liaoning,* the refurbished Cold War–era, Russian, *Kuznetsov*-class aircraft carrier at Dalian shipyard. The ship's air group is taking shape. The PLAN's developmental carrier fighter is a domestically produced, carrier-capable variant of the Russian-designed Su-27 Flanker known as the J-15.[44] The first deck landing of the J-15 on *Liaoning* took place in late November 2012. The J-15 is likely to have avionics, radar, and weapons capabilities similar to the land-based J-11B.

Liaoning is equipped with a ski-jump launch mechanism, and there is a strong possibility that at least the first domestically produced Chinese carrier will be likewise equipped. Accordingly, the PLAN is procuring and developing rotary-wing airborne early warning (AEW) platforms. According to Russian press and Internet reporting, China is taking delivery of up to nine Ka-31 AEW helicopters, while online photographs indicate China has fielded a prototype AEW variant of the Z-8 medium-lift helicopter.[45] At this point it is unknown which will be chosen as the primary AEW helicopter for the PLAN's aircraft carrier force. It is possible the PLAN sees an indigenous platform based on the Z-8 as a long-term solution, with Ka-31s imported from Russia serving as gap fillers.

It is unlikely China is developing aircraft carriers with the intent of employing them against U.S. Navy carrier strike groups in the Central Pacific in a twenty-first-century rehash of the battle of the Philippine Sea. However, this does not mean the PLAN's future aircraft carrier force poses no potential problem for U.S. forces in a conflict in and around China's near seas. In a regional conflict, land-based strike aircraft such as the JH-7A, H-6, J-11B, or Su-30MKK/MK2, as well as conventional ballistic and cruise missiles, could be called on for offensive strikes, negating the need for the carrier's air group to provide U.S.-style offensive force projection. In this case, a carrier and its air group would complement land-based aircraft, extending situational awareness and air defense. PLA doctrine clearly indicates that providing air cover to landing operations in such areas as the South China Sea is one of the primary wartime missions of PLAN aircraft carriers. Both the 2000 and 2006 editions of *Science of Campaigns* discuss the importance of carriers in providing air cover to amphibious invasions against islands and reefs beyond the range of land-based aircraft.[46] The PLA textbook *Winning High-Tech Local Wars: Must Reading for Military Officers* states that one or two aircraft carrier groups should protect amphibious forces engaged in long-distance landing operations and that they should be stationed 100–150 nautical miles from the shore to provide air support to landing forces.[47]

Further, although future PLAN carriers may not represent much in the way of offensive strike potential against U.S. carrier groups in a conflict, they could still play a key role in bringing combat power to bear against U.S. forces. While Adm. Liu Huaqing provided a specific geographic definition for Near Seas Defense, some PLAN officers now view the concept as an evolving one that extends farther out into the Pacific Ocean as the PLAN's ability to operate its forces with "the requisite amount of support and security" increases.[48] Simply put, Near Seas Defense is about more than operating within the First Island Chain. If China's near seas are to be truly secure, the reach of the PLA's aerospace forces must extend beyond the First Island Chain, to engage hostile forces as far out to sea as possible. While *Air Raid and Anti–Air Raid in the 21st Century* does not specifically envision aircraft carriers in a counterstrike role, it does call for fighter units to provide air cover to surface ships and for surface ships to attack enemy aircraft carriers.[49] Given that even China's most modern land-based fighter aircraft cannot provide persistent air cover beyond the First Island Chain, an aircraft carrier could be employed in support of counterstrike operations to provide air defense and antisubmarine protection to surface ships, to get the latter within weapons range of a U.S. carrier group.

Conclusion

As the PLA continues to modernize its forces and develop its counterstrike doctrine, its ability to expand its operations in support of China's Near Seas Defense strategy will increase. A significant element of this growing counterstrike capability is represented by, collectively, the aerospace forces of the PLAN, PLAAF, and Second Artillery. With an increasingly capable inventory of fighter and strike aircraft, conventional ballistic missiles, ground- and air-launched cruise missiles, and eventually fully operational aircraft carriers, the ability of the PLA's aerospace forces to threaten U.S. naval and air forces and bases in the western and Central Pacific will continue to grow. However, in a military dominated by what some officers call the "great infantry" concept, the PLA is inhibited in its ability to integrate its counterstrike capabilities into a joint force that is greater than the sum of its parts. While the PLA's ability to extend its strategic depth in the conduct of near-seas defensive operations is impressive and has grown significantly over the past decade, weaknesses and capabilities gaps still exist, and these will continue to limit the PLA's capacity to defend China's near seas.

Notes

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CHAPTER FIVE

Chinese Air Superiority in the Near Seas

David Shlapak

Among the People's Liberation Army's (PLA's) impressive achievements over the past two decades has been the modernization of its fleet of fighter aircraft. Combined with progress made in other areas, this has substantially increased China's ability to challenge U.S. forces for control of the air over its littoral areas. This chapter will discuss some of the key components of this improvement, including aircraft, weapons, training, and support capabilities.

But first, it is useful to put the changes in the People's Liberation Army Air Force (PLAAF) in an appropriate context. To do so, think back fifty years and imagine an encounter in 1961 between typical Chinese and American fighter pilots. The PLAAF airman would probably have flown a J-6, a variant of the MiG-19, and the U.S. Air Force pilot an F-100. These two jets had broadly comparable performance and similar avionics and weapons. As regards their equipment, the two aviators would have been roughly on par with each other.

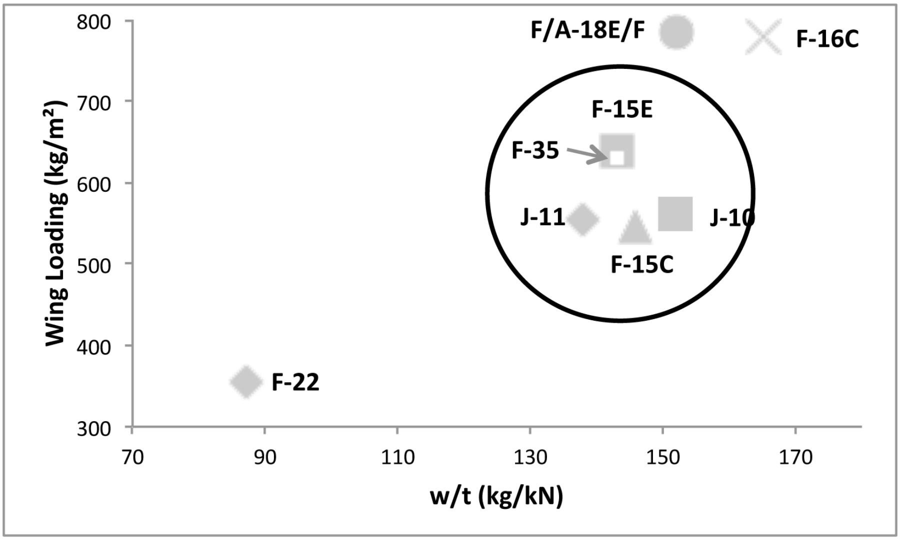
Now visualize a similar meeting thirty-five years later, in 1995. The American pilot would most likely have been flying an F-15, F-16, or F/A-18—a sophisticated "fourth generation" fighter featuring cutting-edge radar and avionics, as well as advanced "fire and forget" air-to-air missiles.[1] The PLAAF pilot, on the other hand, most likely would still be flying a J-6, armed with a Chinese copy of a Soviet copy of a first-generation, short-range U.S. air-to-air missile. The American pilot would have enjoyed an overwhelming qualitative advantage in aircraft, electronics, and weapons.[2]

Advance twenty years to the present day. The United States would most likely be represented by the same F-15 equipped with somewhat updated versions of the same sensors, avionics, and missiles. The PLAAF, meanwhile, could meet it with a J-10 or J-11, both modern fighters comparable in performance to the fourth-generation American jets. The Chinese pilot would likewise have at his disposal weapons and other equipment that reflect rough parity with those found on the typical U.S. fighter.[3]

Performance and Force Size

A second comparison is illustrated in figure 1, which depicts two key performance parameters of a fighter aircraft. Along the *x* axis is plotted weight-to-thrust (w/t) ratio—the weight of the aircraft divided by the thrust of its engine(s), measured in kilograms per kilonewton (kg/kN). This ratio is important in determining the fighter's ability to accelerate and climb. On the *y* axis is wing loading, which is the weight of the airplane divided by the size of its wing, measured in kilograms and square meters, respectively. Wing loading helps determine how well the fighter turns. Together, the two parameters reveal a great deal about an aircraft's maneuverability in both the horizontal (bank and turn) and vertical (climb and dive) dimensions. A lower value is better for each factor, so the farther down and to the left an aircraft lies, the better.

Figure 1. *Characteristics of Chinese and U.S. Fighters*

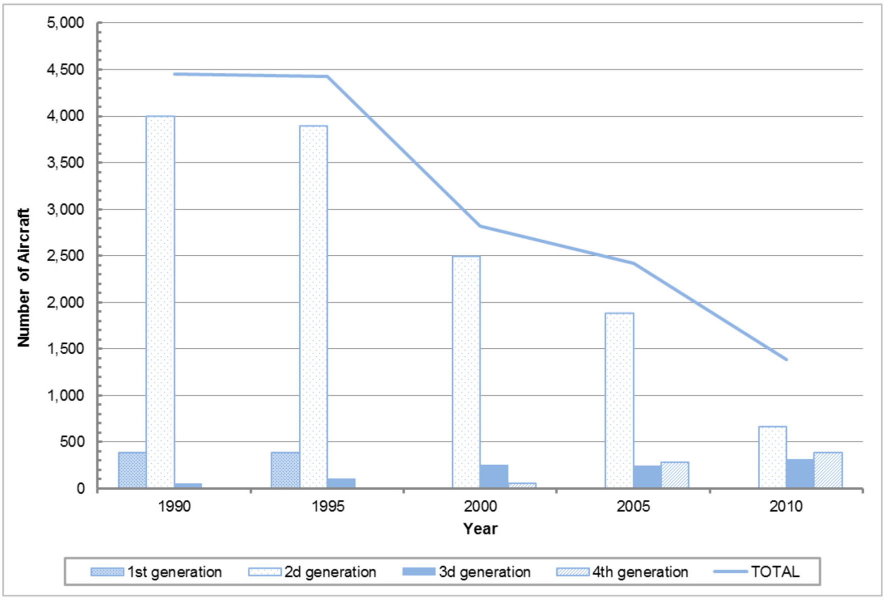


Sources: IHS Jane's All the World's Aircraft: In Service (2012), www.ihs.com/, and author estimates.

Unsurprisingly, the U.S. Air Force's most advanced fighter, the F-22—seen in the figure's lower left corner—is superior on both counts. Up in the top right are the F-16C and the F/A-18E/F, which trail the pack in these two regards. Clustered in the middle are five aircraft: the F-15C, F-15E, F-35, J-10, and J-11. These fighters are in more or less the same space on these two important performance characteristics. The "typical" modern Chinese fighter is as good in these areas as, or better than, the "typical" American jet.

Figure 2 shows how the size and composition of the PLAAF fighter fleet have changed since 1990. The first thing to note is the dramatic shrinkage in the number of China's fighters. Between 1990 and 2010 almost 3,500 obsolete aircraft—*70 percent* of the

Figure 2. *Size and Composition of the PLAAF Fighter Force, 1990–2010*



Source: International Institute for Strategic Studies, *The Military Balance* (London: 1990–91, 1995–96, 2000–2001, 2005–2006, 2011).

force—were retired, mostly after 1995. As a comparison, the U.S. Air Force's fleet of fighter-bombers dropped from a Cold War level of 3,620 in 1990 to 2,650 in 2010—a little over 25 percent. That the PLAAF was willing to shed so many of its aircraft indicates the scope of its modernization efforts as much as does its acquisition of modern aircraft.

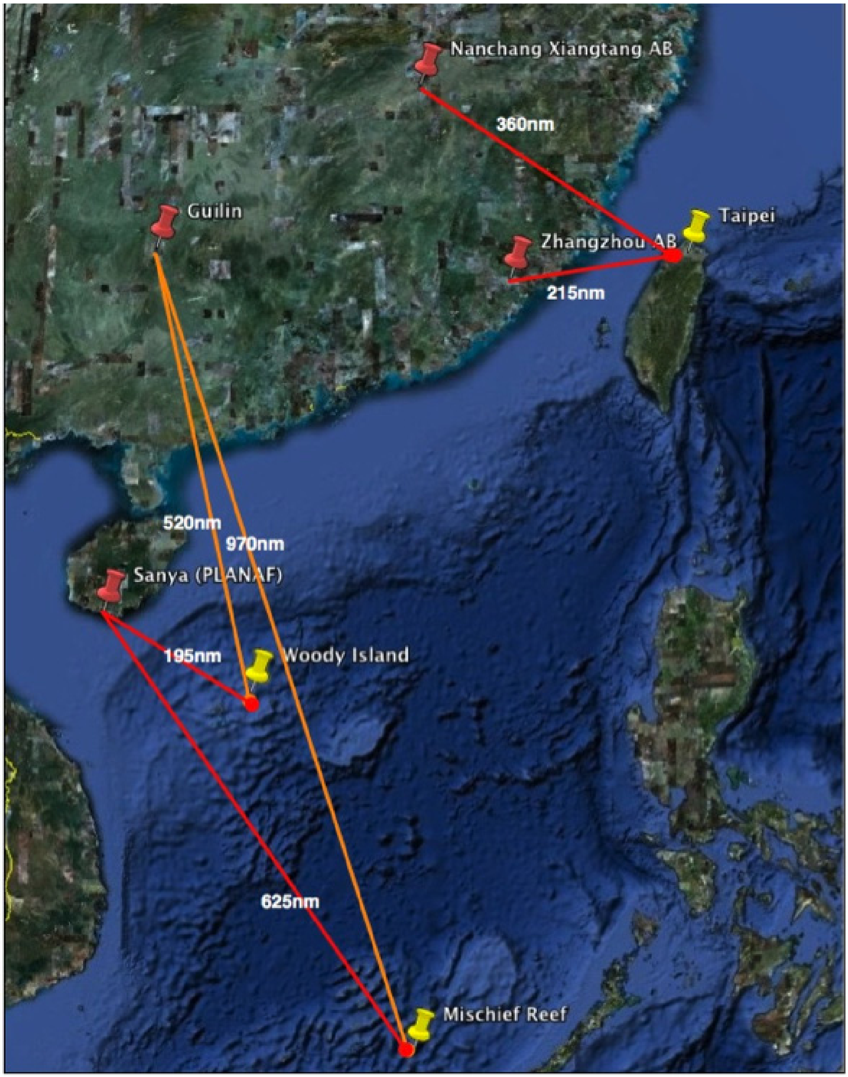
Over roughly the same period, the PLAAF's fighter fleet has undergone a remarkable modernization. As the chart shows, in 2000 only 2 percent of PLAAF fighters were "modern," "fourth generation" aircraft, comparable to the American F-15 and its contemporaries. Little more than a decade later, almost one in three of China's fighters can be considered modern. In fact, only the United States and Russia own more fourth-generation fighters than does the PLAAF; China has more modern fighters than Britain and France combined. Also, in 2011 China joined the United States and Russia as the only countries to fly a stealth aircraft, with the J-20.

The Operational Geography of the Near Seas

How China's air-combat capabilities over the near seas look depends on just how "near" those seas might be. Taiwan's proximity to the mainland, for example, works to the PLAAF's advantage. Its fighters could comfortably reach Taiwan from bases several hundred miles inland, increasing the number of bases (and therefore aircraft) that could be involved and requiring that attacks on those bases have to penetrate deeper into Chinese territory, thereby being exposed to more of China's air-defense network. Other potential operating areas, however, are farther afield from the mainland. Even the South China Sea—scene of multiple confrontations between China and other claimants to those waters—is far enough away to pose challenges to PLAAF operations today.

Figure 3 illustrates these differences. The PLAAF fighter base closest to Taiwan is Zhangzhou, which is about 215 nautical miles from Taipei. The PLAAF base at Nanchang Xiangtang is roughly 260 nautical miles inland but still only about 360 from Taipei.[4]

Figure 3. *Operational Distances: Taiwan versus South China Sea*



In contingencies farther south, distances would be longer. Hainan Island is the Chinese territory closest to the Spratly Islands; the People's Liberation Army Navy (PLAN) aviation base there, at Sanya, is 625 nautical miles from Mischief Reef in the Spratlys. On the mainland, the PLAAF base at Guilin is about 230 nautical miles from the coast—roughly comparable to Nanchang Xiangtang's location relative to the water—but 970 from Mischief Reef.

These greater distances mean, inter alia, longer missions, which consume fuel, cockpit hours, and maintenance resources at an accelerated pace. Absent a credible in-flight-refueling capability, aircraft based at locations like Guilin would have to forward-deploy to be able to reach any fight taking place in or around the Spratlys.

Other factors also reduce China's ability to project combat airpower into the South China Sea. China's arsenal of short- and medium-range ballistic missiles and land-attack cruise missiles represents a serious and growing threat to Taiwan's air bases and to U.S. forces operating out of Okinawa and other locations relatively close to the mainland. However, these missiles would be of less use farther south, where opposing airpower would be based at greater distances from China and U.S. fighters could be flying primarily from aircraft carriers.

Along with added aerial tanking capability, Chinese aircraft carriers could contribute significantly to the PLA's combat capabilities in the South China Sea and beyond. The PLAN's first carrier, *Liaoning,* has made several training voyages, and China began experimental flight operations from it in late 2012. It will provide the PLAN the opportunity to gain experience with the complexity of carrier operations while China builds its first indigenous flattops over the coming years. With a complement of J-15 fighters, *Liaoning* could offer an early capacity for projecting airpower deep into the South China Sea against the less capable navies of the local nations.

Training

China has modernized its doctrine and approach to training as it has its hardware. For example, China reportedly has created at least three "blue force" or "aggressor" squadrons to help make air-combat training more realistic.[5] Consisting of a mix of J-11, J-10, and J-7 aircraft, the force is meant to emulate the performance of the F-15, F-16, and MiG-21 fighters, respectively, in training missions against other PLAAF pilots.[6] The PLAAF's training curriculum has also begun to emphasize flying over water, as well as flying at night, in weather, and in complex electronic-warfare environments. As one expert writes, "Compared to other air forces world-wide, the PLAAF would be considered professional and well trained. In terms of flight hours, safety standards, night-time flying, debriefing, and overall training subjects, the PLAAF is likely approaching NATO standards."[7]

We should expect the PLAAF to continue along this path, producing well-trained aircrews capable of effectively utilizing their modern aircraft and weapons. Regarding platforms, we should anticipate a continuing evolution in which the new replaces the old and the newer augments the new. The PLAAF and the PLA Naval Air Force (PLANAF) are already updating their newest aircraft, including the J-10, J-11, and JH-7. This is not surprising; the Chinese have incorporated a dazzling array of updates into their old J-6, J-7, J-8, and Q-5 aircraft, often modernizing them until very late in their operational careers. The PLAAF's final modernized version of the J-7 (MiG-21), for example, was apparently in production until only a few years ago.[8]

To summarize, while the bulk of the dramatic changes in the PLAAF's force structure may be over, we will likely continue to see improvements building on improvements fairly rapidly and for some time to come.

Key Capabilities and Limitations

For many years, the rigidly controlled, tightly scripted, and operationally primitive training received by PLAAF aircrews was seen as a crippling shortcoming that would have doomed them in combat against any competent adversary. As noted above, evidence suggests that this is changing. The PLAAF does, however, continue to confront operationally important challenges that could impede its performance in combat.

Airpower begins on the ground, where sorties are planned, prepared, and launched. The U.S. Air Force and Navy have invested heavily in the ability to generate sorties efficiently and thus make the most of their available aircraft. There is, in contrast, little evidence in the open literature that the PLAAF has practiced generating large numbers of sorties rapidly, let alone doing it more than once in a day or for multiple days. It is likewise thought that the PLAAF may not have much practice in restoring air-base operations after being attacked. In a shooting war against a competent adversary, this shortfall could be very damaging.

Once in the air, an American pilot would enjoy extensive support from airborne warning and control system (AWACS) aircraft, refueling tankers, and other enabling assets. China has long remained very limited in these areas, but this too appears to be changing. The PLAAF has begun deploying AWACS-type aircraft of its own along with other specialized electronic warfare (EW) aircraft. Ownership of the appropriate platforms, though, is only the first step to an operationally useful capacity. Flight crews and mission crews must be trained, and their capabilities must then be integrated with combat operations, a job that likewise demands substantial training. Like China's nascent carrier-aviation arm, the PLAAF has miles to go before it becomes expert in its airborne-early-warning and electronic-warfare operations. It is, however, clearly on the road.

These limitations may be of less import in scenarios in which operational geography allows the PLA to suppress its adversary's airpower by pummeling its bases. If these attacks enable China to achieve freedom of action in the air early in a conflict, the PLAAF will be less challenged to operate at the frontier of its capabilities than if its pilots had to fight their way through robust, intact defenses. Relatedly, China's plenitude of short-range ballistic missiles would be less useful in a contingency farther abroad, which would leave the PLAAF and PLAN aviation to do more of the heavy lifting in any counterair campaign.[9]

Respective Roles of the PLAAF and the PLANAF in the Near Seas

While PLAN aviation has been modernizing less aggressively than the PLAAF, its capabilities are nonetheless improving. New maritime strike aircraft like the Su-30 and JH-7 are bringing increasing levels of performance and sophistication to China's naval air arm. Naval versions of the J-10 and J-11 are also being brought into the inventory and will probably eventually replace the PLAN's old J-7 and J-8 fighters, although, as with the PLAAF, likely not on a one-for-one basis. The J-15 fighter will eventually come into service aboard China's aircraft carrier. It will certainly be used extensively for training before going to sea operationally, and some J-15s could be assigned to shore-based units in the interim.

While Chinese military thinking extols the importance of fighting jointly, the PLA still has much to do to achieve this goal fully. In the near term, then, PLAN aviation will probably undertake most maritime strike operations, building the necessary packages from its own fleet of fighters and attack aircraft. It will deconflict, but not integrate, with PLAAF operations. The PLAAF, on the other hand, will loom larger in the overall fight for control of the air over both the land and littoral seas. The PLAAF would also probably be counted on for supporting capabilities like aerial refueling.

The Enabling Value of Air Superiority

Of little strategic value in and of itself, control of the air makes it possible to conduct a variety of other operations with fewer constraints. With air superiority, ground forces and surface naval forces may maneuver more freely, and air forces can employ platforms, weapons, and tactics that would not be survivable or effective in other circumstances. In the maritime domain, control of the air reduces the threat to surface forces—both directly, by limiting the sizes, kinds, and azimuths of possible attacks, and indirectly, by permitting maritime-patrol and airborne-early-warning aircraft to fly with greater freedom. This in turn allows naval forces, especially aircraft carriers, to focus their attention on operations other than self-defense, operations that could, of course, include helping win air superiority elsewhere.

For the last twenty years the U.S. military has had the luxury of instant and total air dominance in its combat operations. In the first Gulf War, Iraq's inability to mount any offensive air missions, whether strike or reconnaissance, secured the buildup of forces for the "left hook" that swept through that nation. Iraq's lack of intelligence data and the difficulty with which it moved its forces can both be credited to the total control of the air enjoyed by the coalition from the opening minutes of the war.

The 1982 British campaign to retake the Falkland Islands from Argentina, meanwhile, illustrates the implications of not controlling the air during a maritime operation. Fifteen of the thirty-three Royal Navy surface combatants and amphibious vessels committed to the fight were sunk or damaged. The British also lost ten Harrier fighters, almost 30 percent of the aircraft employed.[10]

As was the case for Argentina, China need not secure total control of the air to cause troubles for an adversary's surface forces. In even contested airspace, important force-multiplying assets—maritime-patrol, airborne-early-warning, and tanker aircraft, for example—would be forced to operate farther back, limiting their ability to locate and attack PLAN submarines, provide warning of incoming air attacks, or extend range and on-station time for American combat aircraft, respectively. This degradation of situational awareness and combat capacity would put Navy surface ships at increased risk of a surprise attack and reduce the amount of offensive combat power being generated.

Denying U.S. forces control of the air or seizing superiority (even if temporary and geographically limited) itself would allow China to limit the freedom of action enjoyed by American surface forces and to threaten current naval concepts of operations. With their control of the air contested, U.S. warships would find themselves compelled to pay more attention to protecting themselves; this would leave fewer assets to project power ashore, which for the past two decades has been the U.S. Navy's focus in regional warfare.

China's New Stealth Aircraft

The long-rumored PLAAF next-generation fighter was revealed to the world on the occasion of its purported first flight in January 2011. The flight came as a surprise to many observers who had agreed with then–Secretary of Defense Robert Gates that China would "have no fifth-generation aircraft by 2020" and only "a handful" by 2025.[11]

The J-20 seems to be a large airplane, and its appearance shows that substantial care was taken to shape the jet for low-observable (LO) characteristics. At this point, all performance specifications are speculative, but the J-20 is thought to have two capacious internal weapons bays and possibly to be capable of "supercruising" flight—flying above Mach 1 without using its afterburners. In both regards, the aircraft would resemble the U.S. Air Force F-22; its larger size suggests, however, that it may have been designed with either a larger internal payload or longer range than the F-22, or both. It may thus be a true multirole fighter, with a substantial strike capability.

Once in service, the J-20 would overmatch every other fighter plane deployed in East and Southeast Asia. As Kopp and Goon write, "With sufficiently good stealth performance to defeat air defense radars in the L-band through Ku-band, the aircraft could easily penetrate all air defense systems currently deployed in Asia."[12]

The J-20's impact on the China–United States balance seems less certain. By the end of the current decade, all three U.S. tactical air forces—the Air Force, Navy, and Marine Corps—should be receiving F-35 fighters in some quantity. Along with the F-22, these F-35s will give the United States an inventory of several hundred stealthy, fifth-generation fighters. We are a long way from knowing enough about the J-20's performance and China's plans for producing it, if indeed the design is meant to go into serial production. Will it be sufficiently stealthy to truly compete with the F-22 or F-35? How would the PLAAF integrate the J-20's employment with its large numbers of nonstealthy aircraft? How many J-20s will China eventually build? It will be years before we have clear answers to these and many other important questions about the new fighter. We can say, however, that if the J-20's debut does little else, it serves as another testament to the increasing capability and sophistication of China's aerospace industry.[13]

An operational stealth fighter would, as noted above, immediately become the most advanced aircraft deployed by any East Asian power. Air forces that today fly aircraft similar to China's Flankers and J-10s—such as those of India, Japan, Australia, Indonesia, and Taiwan—could find themselves for the first time a generation behind the PLAAF. However, India is working with Russia to develop its own stealth fighter, based on Sukhoi's T-50/PAK FA design; Australia is committed to buying fourteen F-35s and may purchase up to a hundred; and Japan is considering the F-35 as a candidate to replace up to sixty-five obsolete F-4EJ fighters. Like the J-20, none of these jets will be operational until much later in the decade, but they could redress the technological balance between these countries and China.

The story is different for the air forces of Indonesia, Taiwan, and all the other militaries in China's neighborhood. None have any likelihood of acquiring fifth-generation capabilities anytime soon. When the J-20 enters service, as noted, it will instantly overmatch any fighter in these air forces' inventories, likely adding to China's military leverage in many of its neighborhood disputes.

With regard to the United States, the J-20 will at the least confront the American military with, in effect, the dilemma that the U.S. Air Force has for twenty years been imposing on adversaries—how to defend against low-observable aircraft. This may prove, however, less dramatic than it sounds. The United States is currently flying its third generation of

LO combat aircraft (the F-35) and has been working with stealth technology since the 1980s. This makes it possible that U.S. aircraft, especially the F-22 and F-35, will prove "stealthier than thou" compared with the J-20, permitting the United States to maintain a margin of advantage even against an indigenous Chinese stealth fighter.

All those years of developing, testing, and operating LO aircraft should also have resulted in the most comprehensive understanding of how to *defeat* stealth. While there is little open discussion of the subject, ideas have emerged. Active electronically scanned array (AESA) radars are intended to track small targets like cruise missiles. The F-35's AESA has, mounted on a test bed, reportedly succeeded in locating the F-22 and even in jamming the latter's radar. Sources have described the potential of low-frequency radars (that is, in the very high and ultrahigh frequency bands) in detecting fighter-sized LO targets.[14]

To the extent that the J-20 turns out to be viable in a squabble versus the United States, it would add a dangerous new element to China's capabilities in a near-seas contingency. A stealthy strike fighter featuring good range and payload could help achieve air superiority over certain maritime areas or reduce the need for classical "air superiority" by being able to operate in airspace that is otherwise denied, just as the F-117 and B-2 have done for the United States in its recent wars. Depending on the sizes and kinds of weapons that might be carried, the J-20 could be an effective surface-attack platform out to several hundred nautical miles at sea—farther, if aerial refueling were used to extend its "legs."

Other Ongoing Developments

In terms of its impact on maritime considerations, a new Chinese aircraft of nearly as much interest as the J-20 is the J-15, a carrier-based fighter adapting—and according to Chinese sources, improving—the Russian Su-33 design. Intended to operate from a ski-jump-equipped ship, the J-15 reportedly made its first flight in August 2009; its first flight off a land-based ski jump took place in May 2010. Unlike the Su-33, which was conceived strictly as an air-to-air fighter, the J-15 may be intended as a multirole aircraft.

Having performed its first carrier landings and takeoffs in late 2012, China has begun taking steps toward operational deployment. While a single, short-deck carrier would make very little difference in a conflict with the United States, the *Liaoning*/J-15 combination would extend China's reach into places like the South China Sea, where the nation's tactical airpower is today somewhat range limited. In these areas, any credible carrier-air capability could overwhelm competitors like the Philippines and Vietnam, whose navies and air forces are small, ill equipped, and outdated.

In recent years China has also displayed a dizzying array of unmanned aerial vehicles and models of them at air, defense, and trade shows; most seem not to have entered production. The unmanned aerial vehicles shown run the gamut from a copy of the Vietnam-era Firebee reconnaissance drone to the Xianglong high-altitude, long-endurance (HALE) unmanned aerial vehicle, which bears a passing resemblance to the U.S. RQ-4 Global Hawk.

China is fielding or developing a range of special-purpose "force multiplier" aircraft as well. For example, the PLAAF has long sought to acquire an airborne early-warning and control platform along the lines of the E-3 AWACS. A program to buy four A-50I aircraft—a Russian Il-76 airframe equipped with Israeli radar and mission equipment—collapsed in 2000 when Israel succumbed to U.S. pressure and dropped out of the deal. After this disappointment China moved forward with its own program, also based on the Il-76 platform but with an indigenously developed mission suite. At least four of these KJ-2000 AWACS aircraft are in active service with the PLAAF, providing its first sophisticated airborne battle-management assets.[15]

Another area of interest to the PLAAF is aerial refueling, which is a necessary competence if China intends to extend the reach of its airpower more deeply into its neighboring seas and oceans. Today the PLAAF possesses a fairly rudimentary capability, owning about twenty-four H-6U tankers equipped with a "probe and drogue" refueling pod under each wing. Relatively few of China's combat aircraft can be refueled in the air: some late-model J-8s have probes fitted, and a fixed probe can be installed on the J-10. The PLAAF's Su-30s have retractable refueling probes, but their system is reportedly not compatible with the H-6U.[16]

In 2005, China ordered thirty-four newly built Il-76 Candid transports and four Il-78 Midas tankers from Russia, but none have been delivered to date.[17] Instead, Russia has begun delivering ten refurbished Il-76s.[18] The PLAAF needs not only additional tankers but also more strategic airlifters to realize any aspirations it might have for power-projection capabilities. A new large transport aircraft, sometimes called the Y-20, is under development; it made its first flight in January 2013.[19]

The PLAAF has also developed about a dozen specialized platforms based on the Y-8 four-engine turboprop transport.[20] This Gaoxin series includes another airborne early-warning and control aircraft, a maritime surveillance variant, an airborne command post, and a number of platforms for various electronic-warfare functions, such as jamming and signals intelligence.

The Future

China's airpower will continue to develop, increasing its capabilities across a wide range of contingencies, including ones in the near seas. What changes might we see in the coming years?

Patterns already in evidence will most likely continue in many areas. Newer jets will steadily replace older combat aircraft; the J-7 and Q-5 will gradually follow the J-6 into retirement, to be replaced by J-10s, J-11s, and JH-7s. Since newer aircraft will not replace older ones on a one-for-one basis, the PLAAF will continue to shrink. It is not clear what China's leadership believes to be the "right size" for its modernized air force, but it is likely that the most dramatic reductions have already been made.

As new models replace old, they will be updated steadily. The PLAAF has never hesitated to modernize and improve its inventory, and there is no reason to expect that to change. Already the PLA has developed multiple variants of the basic Flanker airframe, deployed a J-10B upgrade to the J-10A, and fielded at least one improved version of the JH-7.

At least two brand-new combat aircraft appear likely to become operational before the end of the decade. Both the J-15 and J-20 represent dramatic breakthroughs for Chinese airpower—Beijing's first carrier-based fighter and its first stealthy jet, respectively. It will be interesting to see how many of each the PLA procures and how they come to be operated.[21]

The PLA will likewise continue improving its airborne early-warning and EW capabilities. More KJ-2000 AWACS will probably be built, and we should see additional examples of the Gaoxin group of EW aircraft. Unmanned aerial vehicles will play a big role in these missions as well.

More advanced weapons will continue to accumulate in PLA stockpiles. China already operates several modern air-to-air missiles, including the AA-12 and PL-12 medium-range air-to-air weapons. As we look ahead, it has been reported that China is working on at least three new air-to-air missile designs: an extended-range ramjet-powered version of the PL-12; a short-range active-radar-homing missile; and the PL-ASR, an infrared-seeking missile employing thrust-vector controls that would provide greater agility.[22] The PLAAF may also be interested in very-long-range air-to-air missiles, often referred to as "AWACS killers," for their presumed intended targets. The YJ-91—the Chinese adaptation of the Russian Kh-31 antiradiation missile—has been bruited as a candidate, as has the Russian Novator RS-172. Given China's conviction that information will play a predominant role in future combat, a weapon capable of attacking command, control, communications, intelligence, surveillance, and reconnaissance platforms from extended ranges would seem to make sense.

Conclusion

It is hard not to be impressed with the progress made in recent years by the PLAAF. Not too long ago it was an unsophisticated congeries of ancient aircraft and weapons, its pilots poorly trained and poorly supported. As late as the early 1990s it was likely too weak to have defended China's home airspace effectively against even a modestly competent modern adversary.

In the early to middle 1990s, as Chinese doctrine changed from focusing exclusively on territorial defense to contemplating limited power projection, the PLAAF found itself confronting a number of daunting learning curves that led from where it was to where it needed to be to fulfill its new missions. At least in terms of its major items of equipment, it has largely met these challenges and appears now at least to understand the ones that are left, even if it is not necessarily poised to overcome them immediately.

The revolution in the PLAAF's order of battle is over. It has made up the three decades separating the MiG-19 and the Su-27 in fifteen remarkable years, and it continues to progress. Whether the PLAAF can close the gaps that remain between its capabilities and those of the world's most advanced air forces remains to be seen. Given how it has transformed itself over the last twenty years, however, one would be foolish to bet too heavily against it.

Notes

1. The PLAAF counts fighter "generations" differently than does the United States. China would consider an F-15 or one of its contemporaries a "third generation" aircraft.
2. The last F-100 was retired from the U.S. Air Force in 1979, while the J-6 left PLAAF service only in 2009.
3. In some areas the PLAAF jet might actually have an edge on the U.S. fighter. For example, the J-10B and Flanker variants are equipped with passive infrared search and track (IRST) systems. These sensors can permit a pilot—without emitting a radar signal—to detect another aircraft by "seeing" the heat from its engines, the friction produced as it moves through the air, or the heat signature from the launch of a powered missile. Sukhoi claims that the OLS-35—developed for its Su-35 advanced Flanker—has a front-hemisphere detection range of fifty kilometers and a range of ninety in the rear hemisphere. While the OLS-27 and OLS-30 fitted in China's Su-27/J-11s and Su-30s, respectively, are less capable, no current-generation U.S. fighter has an IRST at all, nor will the F-22 incorporate one. The F-35, however, will mount an IRST, and programs are under way to backfit one on some F-15C and F/A-18E/F aircraft.
4. Bases farther inland have the advantage of being more secure against attack, since more of China's defended territory would have to be overflown to reach them.
5. "'Bad Guy' Su-30MKK of the PLAAF 8th Flight Academy," *China Defense Blog,* 2 February 2010, china-defense.blogspot.com/.
6. *Jane's World Air Forces,* s.v. "China," updated 30 November 2012, www.janes.com/. India continues to operate a number of MiG-21s, along with its newer MiG-29s and Su-27s and -30s.
7. Wayne A. Ulman, *China's Emergent Military Aerospace and Commercial Aviation Capabilities,* testimony before the U.S.-China Economic and Security Review Commission, 111th Cong., 2nd sess., 20 May 2010, available at www.uscc.gov/.
8. Hence Ken Allen's memorable observation that China operates "the most highly perfected obsolete aircraft in the world." Andrew J. Nathan and Robert S. Ross, *The Great Wall and the Empty Fortress* (New York: W. W. Norton, 1997), p. 146.

9. China could, over time, increase its holdings of medium- and intermediate-range ballistic missiles in an effort to present a more lethal threat to distant enemy bases. Longer-range missiles are more expensive than shorter-range ones, but this is certainly a possible course of action.
10. Ship losses from Max Hastings and Simon Jenkins, *The Battle for the Falklands* (New York: W. W. Norton, 1983), app. A. Air losses from Rodney A. Burden et al., *Falklands: The Air War* (Poole, Dorset, U.K.: Arms and Armour, 1986).
11. Robert H. Gates (speech delivered at the Economic Club of Chicago, Chicago, Ill., 16 July 2009), available at www.defense.gov/.
12. Carlo Kopp and Peter Goon, *Chengdu J-XX [J-20] Stealth Fighter Prototype: A Preliminary Assessment,* Technical Report APA-TR-2011-0101 (n.p.: Air Power Australia, 3 January 2011), www.ausairpower.net/. Bill Sweetman, "Chinese J-20 Stealth Fighter in Taxi Tests," *Aviation Week,* 3 January 2011.
13. A second stealthy Chinese fighter, dubbed the J-31, flew for the first time in late 2012.
14. David A. Fulgham et al., "Chinese J-20 Vulnerable," *Aviation Week & Space Technology,* 18 January 2011; Carlo Kopp, *Russian/PLA Low Band Surveillance Radars (Counter Low Observable Technology Radars),* Technical Report APA-TR-2007-0901 (n.p.: Air Power Australia, updated April 2012), www.ausairpower.net/.
15. The delivery of an additional two KJ-2000s was reported in 2008. Cliff writes, "China operates at least a dozen AEW&C [airborne early warning and control] aircraft," a number that probably includes the Y-8-based model mentioned later in this discussion. Roger Cliff, *The Development of China's Air Force Capabilities,* testimony before the U.S.-China Economic and Security Review Commission, CT-346 (Santa Monica, Calif.: RAND, 20 May 2010).
16. Gabe Collins, "Air Time: Increasing China's Aerial Range," *Jane's Intelligence Review,* 12 June 2008.
17. "Delivery Terms for Il-76 Aircraft to China May Be Revised," RIA Novosti, 7 March 2007, available at GlobalSecurity.org/.
18. Alexander Zudin, "Russia Delivers Refurbished Il-76s to China," *Jane's Defence Weekly,* 3 January 2013.
19. Robert Johnson, "China's Heavy Transport Plane Makes Its First Flight," *Business Insider: Military & Defense,* 28 January 2013, www.businessinsider.com/.
20. The Y-8 is a Chinese version of the Soviet An-12 transport, very similar to the U.S. C-130 Hercules, which itself has served as a platform for a variety of special-mission aircraft.
21. It also remains to be seen whether the PLA will choose to deploy any J-15s ashore or to employ them strictly from aircraft carriers.
22. Carlo Kopp, *PLA Air-to-Air Missiles,* Technical Report APA-TR-2009-0802 (n.p.: Air Power Australia, updated April 2012), www.ausairpower.net/.

Land- and Sea-Based C4ISR Infrastructure in China's Near Seas

Eric D. Pedersen

The nature of Chinese activity in the near seas has changed drastically over the past five years, and this change will affect China's command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) requirements, as well as the efficacy of the infrastructure that had been developed under the old model. What was once largely the province of the People's Liberation Army (PLA) Navy is now shared by the "five dragons" of China's maritime law-enforcement agencies. However, this change seems to have occurred without an associated transfer of C4ISR systems from the military to these agencies. As a result, the maritime law-enforcement agencies either are left at the mercy of the PLA Navy for whatever information it chooses to provide or must develop their own capabilities to collect the same information.

This chapter examines the tools that China—largely the PLA—has at sea and on shore to build a picture of activity in the near seas and how that picture is distributed to those who need it, both inside and outside the originating organization.

C4ISR Functions in the Near Seas

Over the past few years, China has placed increased emphasis on advancing its interests in the near seas with an increasingly robust set of maritime law-enforcement agencies, as opposed to the PLA Navy. These agencies include the Maritime Safety Administration and a newly consolidated China Coast Guard under the State Oceanic Administration, which includes the former China Marine Surveillance, the Bureau of Fisheries' Fisheries Law Enforcement Command, the older, more limited China Coast Guard, and the General Administration of Customs. A detailed review of each of these agencies' functions is beyond the scope of this chapter, but their growing importance in the overall defense of China's maritime rights and interests is illustrated by their inclusion in the 2010 iteration of China's defense white paper.[1] China appears to be establishing a pattern of treating increasingly large portions of the near seas as its maritime territory and is thus using maritime law enforcement to administer it rather than solely depending on the PLA Navy to defend it.

Executing the missions China has assigned to its maritime forces in the near seas is no small task. Senior PLA officials often assert that China has a three-million-square-kilometer "territorial sea area."[2] Whether China means this to be territorial waters as defined by the United Nations Convention on the Law of the Sea, the country's exclusive economic zone, or some other definition is unclear; Chinese officials have never explicitly stated where that extent reaches or what it means. But the sheer size is suggestive. Three million square kilometers can encompass virtually the entire near-seas area, including the Bo Hai, the Yellow Sea, the East China Sea, and the entire area of the South China Sea encompassed by the "nine-dash line." Regardless of the type of sovereignty or jurisdiction the Chinese claim in these waters, it is evident they need to be able to monitor activity in them and that they feel they are still short of that goal. Early in 2011, a senior official for one maritime law-enforcement agency stated that China's maritime surveillance capability remained "weak," given the large area of responsibility.[3]

The efforts of the PLA Navy and the various maritime law-enforcement agencies to enforce China's claims in the near seas have been well documented over the past two years. News reports have detailed China Marine Surveillance patrols in the South China Sea, to include run-ins with Vietnamese patrol ships. China Marine Surveillance documented a nearly fivefold increase in the number of foreign ships it monitored between 2008 and 2010.[4] The Bureau of Fisheries' Fisheries Law Enforcement Command reportedly established regular patrols to the disputed Senkaku (or Diaoyu) Islands in December 2010, following an intense controversy in which Japan briefly detained a Chinese fishing boat crew that had rammed a Japan Coast Guard ship.[5]

In order for these agencies to accomplish the missions that they have apparently been given by the Chinese government, they have embarked on shipbuilding programs. Also, in late 2012 as many as eleven ships were transferred from the PLA Navy to China Marine Surveillance and the Bureau of Fisheries' Fisheries Law Enforcement Command.[6] But the mere addition of ships is not enough for these agencies to succeed in areas increasingly far from shore. They must build a picture of activity in the areas they are charged with patrolling, to provide their commanders with the information necessary to deploy their assets intelligently, and they must find a way to disseminate their orders and required situational awareness to the patrol ships responsible for carrying those orders out. They too, like the PLA Navy, need an increasingly sophisticated C4ISR system.

This emphasis on the expanding role of the maritime law-enforcement agencies should not lead one to believe that the PLA Navy has ceded all missions in the near seas, however. There are still many missions that it is responsible for executing, either independently or in coordination with maritime law enforcement. Besides routine training, the PLA Navy does its share to remind the region of Chinese claims to disputed waters. In

February 2010, the PLA Navy's first amphibious dock landing ship, *Kunlunshan,* trained in the South China Sea and held a ceremony to leave "sovereignty monuments" at James Shoal, China's southernmost territorial claim.[7] James Shoal is nearly a thousand nautical miles from the nearest point on the Chinese mainland and represents the farthest reaches of the near seas. It is a true challenge to monitor maritime activities across such a vast area. In the next section we will examine the land- and sea-based tools the PLA Navy and the maritime law-enforcement agencies are developing to build a picture from their coastline to James Shoal.

Intelligence, Surveillance, and Reconnaissance

The main purpose of intelligence, surveillance, and reconnaissance, or ISR, systems in China's near seas is to gather information about who is operating where. The PLA Navy must know in order to guard the country from attack, and the maritime law-enforcement agencies must know in order to fulfill their myriad of functions, from the more mundane enforcement of pollution laws to the more ominous assertion of China's maritime sovereignty claims. Many of the systems China's maritime agencies use to keep track of the at-sea picture were originally developed for the PLA Navy's core mission of coastal defense.

Active Radar Systems

Conventional coastal radars are limited by the radar horizon, which varies depending on antenna height and target size but is around twenty nautical miles, as a good rule of thumb.[8] Such a short range is inadequate for two reasons. First, it is hardly far enough to view activity much farther out than the twelve-nautical-mile limit, certainly not to the breadth of China's near seas. Second, it would take several hundred such radars to cover China's coastline, over 7,800 nautical miles long.[9] However, there are several types of over-the-horizon radars (OTHRs) that China is using to increase the surveillance area significantly. These most notably include high-frequency surface-wave radars (HFSWRs) and sky-wave OTHRs.[10]

HFSWRs use the longer propagation of lower-frequency electromagnetic waves to detect targets much farther out than conventional radars can. As with many complex systems, exact performance depends on many factors, but a detection range on the order of a hundred nautical miles appears achievable.[11] The height of a particular ship strongly influences the target-return strength, which has limited the usefulness of radar as a long-range ship-tracking system.[12] However, China appears to have been investigating this area closely. A study partly funded by the national 863 Program tested tracking of targets using a multiband system, and the results compared favorably with simultaneous tracking by the Automatic Identification System (discussed below).[13] The experiment report stated the multiband system was designed to detect targets to 150 kilometers, though its full range was not used in that particular trial.[14]

Sky-wave OTHRs are designed to track targets even farther from shore than HFSWRs. While little is known about China's sky-wave OTHR, some characteristics can be inferred from similar systems already in use. Both the United States and Australia currently operate sky-wave radars—the United States primarily for detection of drug-smuggling aircraft, and Australia for monitoring of air and sea activity by the Royal Australian Air Force.[15] Sky-wave OTHR bounces signals off the ionosphere, achieving very long ranges, on the order of 1,600 nautical miles. Since the energy approaches the target from a nearly vertical angle, it is thought to be especially useful in detecting low-flying and even stealth aircraft. Its dependence on Doppler for target discrimination makes aircraft much easier targets for it than ships, and variations of the ionosphere greatly affect its performance.[16] The description of China's system in the 2011 report *Military and Security Developments Involving the People's Republic of China* appears to confirm these broad estimates, stating that China's sky-wave system "allows [China] to carry out surveillance and reconnaissance over the western Pacific."[17] The extreme range of sky-wave systems and the fact that there are many other ISR options available for coastal areas suggest that this system is primarily designed for use in the outer edges of the near seas, even into the far seas.

While both the HFSWR and sky-wave have practical applications, they have serious drawbacks as well. China may be looking at a hybrid surface/sky-wave radar to maximize the benefits of both and eliminate some of their problems. This system would use a sky-wave radar transmission—that is, it would bounce the signal off the ionosphere—but the receiving antenna would detect the returns via surface-wave propagation. This would theoretically produce extended ranges compared to an HFSWR, allow for surface and air target detection, and maintain some of the stealth detection capabilities of the sky-wave radar.[18]

Passive Electronic Surveillance

In addition to shore-based active radars, China uses land-based electronic surveillance to aid in monitoring its coastal waters and airspace, though to what extent is unclear. At the 2005 International Defence Exhibition China displayed information on a ground-based passive detection system similar to the Kolchuga system (originally Soviet, now Ukrainian). The exhibition display claimed the system could triangulate electronic emissions from ships and aircraft to ranges between two hundred and three hundred kilometers.[19]

Self-Reporting Mechanisms

China also uses two types of self-reporting mechanisms to monitor ships in its claimed waters. The best known is the international standard Automatic Identification System

(AIS), which is required on most commercial vessels by the International Maritime Organization.[20] The AIS transmits ships' data, including position, course, and speed, on a VHF band; the data are available to any ship or shore station with the appropriate equipment. This system not only helps commercial ships avoid collisions but enables port traffic management and gives maritime law-enforcement patrol ships and shore stations clear pictures of the ships around them. Saab installed China's coastal monitoring system for AIS and in 2010 was awarded a contract by the Maritime Safety Administration to provide a similar network for major in-shore waterways.[21] AIS is extremely useful for vessel monitoring, though it provides a relatively short-range (less than a hundred nautical miles) picture, owing to the limitations of VHF propagation.

Some may argue that the second type of self-reporting system should properly be considered space based, but it has critical sea- and ground-based components. It is also a uniquely Chinese system and appears to be a critical method of tracking the Chinese fishing fleets, so this section would be incomplete without mention of it. This is the Beidou satellite navigation system, which some term the "Chinese GPS." There is a critical difference in its operation, however. A traditional global positioning system uses signals from satellites to calculate positions on the earth. Beidou, however, is an active system; a user transmits information via satellite to a ground station, which calculates the position of the user and transmits it back. This active system allows for monitoring of users' locations and permits users to transmit other data to the ground station as well. This system has been put into place on over twenty thousand Chinese fishing boats, enabling their location to be constantly monitored by fisheries authorities.[22]

Systems that self-report ship identifications and positions like AIS and Beidou have obvious advantages for enforcing domestic laws and managing international maritime traffic. They also help sort out a complex radar picture, allowing the PLA Navy and maritime law-enforcement agencies to concentrate patrol efforts on identifying radar contacts having no associated AIS or Beidou data.

Tactical Assets

Besides the largely shore-based systems described above, the PLA Navy and each of the maritime law-enforcement organizations maintain tactical assets that patrol their respective areas of responsibility and represent the final options in any ISR network. If activity is unclear or there is a hole in ground-based monitoring systems, the only thing to do is to go out and take a look. Besides traditional surface-search radars, it can be assumed that many of the PLA Navy and maritime law-enforcement ships possess AIS systems that would help supplement the wide-area radar picture.

The PLA Navy is also beginning to develop some very sophisticated ship-based radars that provide much greater awareness than traditional air- and surface-search radars.

The Luyang II–class destroyers incorporate China's first ship-based phased-array radars, similar to the U.S. Aegis AN/SPY-1 system.[23] China's destroyers of the *Sovremenny* and Luyang I and II classes deploy the Russian Mineral-ME system, which possesses both active and passive detection systems, as well as an integrated data link for sharing targeting information.[24]

PLA Navy ships, in addition, would have passive electronic support measures (ESM), which can intercept and identify other ships' radar signals. It is unclear from publicly available materials whether maritime law-enforcement ships have such systems, but they are less likely to; with thousands of commercial ships all using off-the-shelf radars, it is unlikely that an ESM system would be very useful. It makes more sense for the PLA Navy, which would have special interest in the more unusual signatures of foreign military radars that could be operating in a given area.

In sum, China's ground- and sea-based ISR capabilities fall into three primary areas. The first is ground-based radar, which, with new OTHRs, can provide an accurate picture of activity but not identifying information. The two self-reporting mechanisms discussed can provide detailed information on contacts, but AIS is limited by range, and Beidou is fitted only on Chinese vessels. Finally, the various patrol ships must help cover the remaining area, but they are limited by numbers. Thus, for the near seas, while ground- and sea-based ISR systems can provide persistent and accurate surveillance out to perhaps a hundred nautical miles from shore, the farther reaches must be monitored either by patrol ships or by air- and space-based assets, which are less constrained by the distances involved but also more intermittent in their coverage.

Command, Control, Communication, and Computers

C4ISR does not stop with developing networks of sensors to gain awareness of areas of responsibility. C4ISR also includes the mechanisms for fusing such information, enabling command decisions, and disseminating those decisions to subordinate units. This portion of the C4ISR equation is usually less visible and less concrete than the ISR systems themselves, and thus it is often examined less thoroughly.

Creating a Fused Picture

For the extensive ISR assets described in the previous section to be most effective, the information from all must be fused to present a cohesive picture. This would allow commanders in the various organizations to make informed decisions regarding the best use of their respective forces. This is not a trivial matter, particularly across multiple organizations. The most efficient use of China's ISR assets would be to fuse information from every sensor into a single picture, and then to disseminate it to each agency, which could filter it to display the data required. However, this would be exceedingly complex and would require a level of coordination and standardization among multiple agencies that does not exist at this time. It appears that some common data may be shared, but to what extent is unclear. Basic data such as those from a coastal radar network are the type most likely to be shared, while more specialized data, such as electronic surveillance or reporting from individual patrolling units, are probably kept within the originating agency unless there is a specific need to share. Each agency must therefore use its own assets to fill in gaps as it requires.

Descriptions of how such data fusion occurs are difficult to come by, particularly for the PLA Navy. However, foreign observers have been allowed into some coordination centers of the maritime law-enforcement organizations. One of the best descriptions of such a facility comes from Professor Lyle Goldstein of the U.S. Naval War College, who visited the Shanghai Maritime Safety Administration Rescue Coordination Center in 2007.[25] He describes a modern ship-tracking facility that is supplemented by eleven radar stations and two other tracking stations.[26] But even the primary Rescue Coordination Center, in one of China's busiest ports, shows seams, gaps in information. For example, the Rescue Coordination Center could display the locations of its own assets, but it apparently did not have up-to-date information on where China Coast Guard ships were.[27]

With a few such exceptions, little is known about exactly how and where data are fused among the various agencies. The author postulates that each major division of each organization likely has a data-fusion center to support the decisions of that division's commander. The PLA Navy, State Oceanic Administration, and the Fisheries Law Enforcement Command each have three major organizational break points, described as North Sea, East Sea, and South Sea areas or fleets.[28] These relatively large divisions would make sense for these agencies, whose responsibilities are spread throughout the near seas.

In contrast, the China Coast Guard and Maritime Safety Administration, whose missions are concentrated closer to the coast, have a larger number of smaller areas of responsibility. Both agencies have flotillas or subordinate bureaus in each of the eleven coastal provinces; the Maritime Safety Administration also has bureaus in the port of Hong Kong, as well as in Heilongjiang and Hubei to manage major inland waterways.[29] The maritime pictures for each of these agencies would likely be more detailed in the near coastal areas, offering much less insight into activities in the farther reaches of the near seas.

Coordinating Activities

As China places more importance on its near-seas claims and the agencies that enforce them, cooperation between those agencies becomes more important. Besides promotion of economy of resources, there appear to be increasing areas in which several entities have key interests. These common interests drove a recent consolidation of maritime agencies under a single agency to deal with frequent coordination problems.

The first hint of how limited cooperation was under the former system is the diversity of ministries that controlled the various maritime agencies. Prior to the spring of 2013, there was no common chain of command below the State Council level for any two of the major civilian maritime agencies. The State Oceanic Administration, Bureau of Fisheries' Fisheries Law Enforcement Command, Maritime Safety Administration, China Coast Guard, and the General Administration of Customs fell, respectively, under the Ministry of Land and Resources, the Ministry of Agriculture, the Ministry of Transportation, the Ministry of Public Security, and the State Council.[30] To include the PLA Navy, one had to go all the way to the Politburo to find a common decision-making body, as only that entity includes senior members of both the State Council and the Central Military Commission.

At the 2013 National People's Congress, many of these agencies were restructured so as to fall under the State Oceanic Administration as a new, consolidated China Coast Guard.[31] Additionally there is, as noted, growing evidence that the PLA Navy, the new China Coast Guard, and the Maritime Safety Administration are beginning to share information and coordinate in specific areas. But the mechanisms for that cooperation likely had to be approved at the highest levels. Such a burdensome chain severely limits the flexibility of the maritime agencies in attempting to respond to emerging situations in a comprehensive manner.

This wide separation of chains of command has obvious implications for the coordination of activities, but also it gives rise to uncoordinated decisions that seem innocuous but could result in significant hurdles down the road. Different organizations are apt to develop different ways of processing and exchanging information. For example, even if the Maritime Safety Administration were authorized to share its AIS data with the new China Coast Guard, if the latter's networks were not able to accept and process those data, significant investments in both time and expense might be required. Similar challenges could occur in the realm of communications. Various ships and aircraft could presumably communicate on standard marine frequencies, but secure communications, data transfer, and participation in multipoint nets would not be possible unless prior coordination ensured compatibility of equipment and procedures.

Over the past several years, there have been signs that some improvement in coordination is beginning to take place. The 2010 iteration of China's defense white paper mentioned for the first time the roles of the civilian maritime enforcement agencies and hinted at formal coordination between the PLA and civilian agencies when it stated in the same section that "all military area commands, as well as border and coastal provinces, cities and counties, have commissions to coordinate border and coastal defenses within their respective jurisdictions."[32] The State Oceanic Administration appeared to have a more formal relationship with the PLA Navy than the other maritime law-enforcement agencies, which may have contributed to its selection to lead the new China Coast Guard. In 2008, the deputy director of the State Oceanic Administration's China Marine Surveillance organization announced it would become a "reserve unit" of the PLA Navy.[33]

In addition to the examples above, an incident clearly illustrates that the barriers between the various maritime agencies can be overcome for particular situations. When the USNS *Impeccable* (T-AGOS 23) was harassed in the South China Sea on 8 March 2009, ships from three different organizations were on the scene. Two fishing trawlers conducted the most dangerous maneuvers, but ships from the State Oceanic Administration, Bureau of Fisheries' Fisheries Law Enforcement Command, and the PLA Navy were all in the immediate vicinity.[34] Such a coordinated action among three agencies had not been seen before and has not been seen again since, but it is illustrative of the type of action that can occur if the appropriate authorities are given.

Implications for the Future

Over the coming years, C4ISR management will be a determining factor regarding whether China can effectively execute its maritime missions in the near seas. To execute those missions successfully, China must be able to build an accurate picture of activity and, when necessary, to coordinate actions between agencies both at sea and ashore. These are not easy tasks, given the vast expanse of the near seas and the disparate nature of the organizations potentially involved.

The ground- and sea-based ISR assets described in this chapter highlight some of the very complex issues with building a fused picture over such a vast and diverse area. They hold certain significant advantages over air- and space-based systems, but on their own they cannot provide the complete picture.

A chief advantage of ground- and sea-based systems over airborne and most space-based systems is persistence. Ground-based radar, electronic surveillance, and AIS stations can monitor their areas continuously, and they have access to large communication "pipes" that can get vast amounts of information to fusion centers quickly. Sea-based platforms provide a bridge between shore-based assets and the more mobile air and space assets. They can loiter for days at a time, and they provide information of arguably greater fidelity than can any other ISR platform.

The tyranny of distance continues to be the primary enemy to accurate information. Systems that, like OTH radars, can observe vast areas at extended ranges provide little in the way of identification regarding the types of ships they are observing. Yet systems that provide more complete data, such as AIS or visual observation by patrol ships, are limited to the narrow slices of the near seas that they are able to observe at one time. The only system that appears to provide detailed information over a wide area—the Beidou—does so only for Chinese ships equipped with appropriate and working equipment and is therefore of limited use in identifying what the PLA Navy and maritime law-enforcement agencies are most interested in—foreign or illegal activity.

With vast areas to enforce, coordination between agencies can only increase the efficiency of their efforts, which could set the stage for more contentious interactions with ships from regional countries or even the United States. Increasing awareness of foreign activities throughout China's claimed waters and more efficient use of ever-growing maritime-agency fleets will enable China to enforce its claims more stringently. Increased interaction with foreign ships farther from mainland China could spark at-sea incidents that result in unintended escalation of tensions at best and regional conflict at worst.

At the end of the day, increased C4ISR capabilities throughout the near seas are a magnifying glass for China's maritime policies. Where those interests are in harmony with those of other regional actors, China will bring welcome abilities to bear, but where those interests diverge, increasingly dangerous situations could arise.

Notes

1. People's Republic of China, *China's National Defense in 2010* (Beijing: Information Office of the State Council, March 2011), p. 17, available at news.xinhuanet.com/. For an overview of China's maritime enforcement agencies, see Lyle J. Goldstein, *Five Dragons Stirring Up the Sea: Challenge and Opportunity in China's Improving Maritime Enforcement Capabilities,* China Maritime Study 5 (Newport, R.I.: Naval War College, April 2010).
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7. Hou Yaming, "Up Close to China's Warship No. 1," *Beijing Jianchuan Zhishi,* 1 July 2010, p. 18.
8. Radar horizon in nautical miles is roughly calculated as

   $$1.23(\sqrt{\text{height of radar}} + \sqrt{\text{height of target}}),$$

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Chinese Air- and Space-Based ISR

Integrating Aerospace Combat Capabilities over the Near Seas

Andrew S. Erickson

China's progressively more potent naval platforms, aircraft, and missiles are increasingly capable of holding U.S. Navy platforms and their supporting assets at risk in the near seas and their approaches. Central to maximizing Chinese ability to employ these systems—and hence to consolidating China's aerospace combat capabilities over the near seas—are its emerging command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities. These systems will enable the Chinese military to strengthen coordination, cueing, reconnaissance, communications, and data relay for maritime monitoring and targeting, as well as to coordinate Chinese platforms, systems, and personnel engaged in these roles. Particularly important will be effective utilization of ISR, the collection and processing of information concerning potential military targets. Many platforms and systems can support such operations; this chapter focuses on those dedicated to such purposes, with the exception of unmanned aerial vehicles (UAVs) and helicopters, both of which are growing in importance but on which data are more difficult to verify at this time.

The successful achievement of high-quality real-time satellite imagery and target-locating data and fusion, as well as of reliable indigenous satellite positioning, navigation, and timing (PNT), would facilitate holding enemy vessels at risk via devastating multiaxis strikes involving precision-guided ballistic and cruise missiles launched from a variety of land-, sea-, undersea-, and air-based platforms in coordinated sequence. Emerging space-based C4ISR capabilities could thus greatly increase China's capacity to assert its interests militarily in, over, and beneath the near seas. Beijing has a clear strategic rationale and corresponding set of programs to master the relevant components, particularly for "counterintervention" operations in and around its near seas. Doing so could finally enable the People's Liberation Army (PLA) to translate its traditional approach of achieving military superiority in specific times and areas, even in a context of overall inferiority (以劣胜优), into the maritime dimension.

China has many ways to mitigate its limitations in C4ISR and target deconfliction for kinetic operations within the near seas and their immediate approaches, and potentially also for nonkinetic peacetime operations farther afield. Conducting high-intensity wartime operations in contested environments beyond the near seas, by contrast, would require major qualitative and quantitative improvements, particularly in aerospace, and impose corresponding vulnerabilities.

This chapter reviews dedicated Chinese air- and space-based ISR systems, examines one relevant operational scenario (tracking hostile surface ships in and around the near seas), considers China's remaining limitations, and concludes by assessing strategic implications for China's military and the U.S. Navy.

China's C4ISR Foundation and Emphasis

The PLA decided that it was necessary to develop "an integrated C4ISR system" in the early 1990s.[1] This was motivated by observations of U.S. prowess in Operation DESERT STORM, the U.S. role in the 1995–96 Taiwan Strait crisis, and the 7 May 1999 Belgrade embassy bombing. The subsequent development of network-centric warfare added further impetus. In addition to the cumulative impact of these events, it was perhaps physical destruction and damage to sovereignty by the Belgrade bombing that most strongly reinforced Jiang Zemin's visionary thinking concerning the future of warfare and catalyzed the support of other top leaders for decisive investment to realize this goal. Accordingly, in May 1999, China initiated the 995 Program (995 工程) to support megaprojects for the development of "assassin's mace" weapons, which promised disproportionate effectiveness vis-à-vis a top military power, such as the United States, despite China's overall technological inferiority.[2]

Essential to the integration and employment of the assassin's mace weapons thus developed since the late 1990s, Chinese C4ISR capabilities have improved markedly in parallel. This has occurred as part of a larger effort at "informatization," facilitated in part by development in civilian information technology and the telecommunications industry. As of China's 2008 defense white paper, the PLA aspired to establish a foundation for informatization by 2010, achieve major progress by 2020, and realize informatization by 2050.[3] In 2000, the PLA issued a manual, or outline (纲要), detailing the construction of "command automation systems," or "military information systems that possess command and control, intelligence and reconnaissance, early warning and surveillance, communications, electronic countermeasures, and other operational and information support capabilities with computers as the core."[4]

Over the next decade, "the PLA began to develop and field airborne and space-based ISR technologies, and it was during this time that Chinese military analysts began to consider the requirements and applications of C4ISR systems to be used by the PLA."[5] Today, in Larry Wortzel's assessment, "China's military reconnaissance capability is probably similar to the capabilities of Western sensor systems of the 1990s, a location to about ten meters in accuracy, clock geosynchronous signals to within 50 nanoseconds, and velocity to within 0.2 meters per second."[6] The Central Military Commission (CMC) and the General Staff Department (GSD) command center are linked redundantly with alternate command posts, military region headquarters, and subordinate units operating up to, and in some cases beyond, the "First Island Chain."[7] While the PLA has not achieved the level of situational awareness of its American counterpart, which can extend data-sharing to the individuals in many respects, all the PLA Navy's (PLAN's) "major combat ships are networked and can share data. In the PLA Air Force, a majority of newer fighter aircraft are able to share data and be part of an information system managed by the PLA's own airborne early-warning aircraft. For the ground forces, it looks like automation and information age systems have penetrated down to the regimental level."[8]

According to the U.S. Department of Defense, as of 2012 "the PLA [was] focused on developing C4ISR systems that will allow the military to share information and intelligence data, enhance battlefield awareness, and integrate and command military forces across the strategic, campaign, and tactical levels. A fully integrated C4ISR system, as envisioned by PLA leaders, would enable the PLA to respond to complex battlefield conditions with a high level of agility and synchronization."[9]

More broadly, developing a "high-resolution earth observation system," to include an "airborne remote sensing system" and a "national satellite remote sensing (ground) network system," is among sixteen national megaprojects prioritized in China's Eleventh Five-Year Plan (2006–10) and the "Outline of National Medium- and Long-Term Science and Technology Development" (2006–20).[10] This priority guarantees top leadership support and tremendous institutional, financial, and human resources.

Near-real/real-time C4ISR is facilitated increasingly by China's integrated Qu Dian (区电) military C4ISR system, which enables civilian and military leaders to communicate with forces in-theater using secure fiber-optic cables and both high-frequency and very-high-frequency communications and microwave systems, as well as related wireless networks and data links. These latter include airborne radio and communications relay and secure PLA voice/data communications provided by Fenghuo/Zhongxing/Shentong communications satellites. According to China's 2010 defense white paper, "The total length of the national defense optical fiber communication network has increased by a large margin, forming a new generation information transmission network with optical fiber communication as the mainstay and satellite and short-wave communications as assistance."[11] This system may be the equivalent of the U.S. Joint Tactical Information Distribution

System; China has developed, and possibly deployed, a related Triservice Tactical Information Distributed Network (三军战术数据分发系统).[12] These capabilities are currently structured to support near-seas operations. Extending high-intensity coverage much beyond the near seas, however, would be far more difficult in many respects.

Airborne ISR

Aircraft play an essential role in maritime reconnaissance because they are typically easier and cheaper to acquire than satellites and also because they can be rapidly redirected to new areas of priority in a fluid tactical environment. China's fixed- and rotary-wing aircraft and UAVs contribute to peacetime signals intelligence (SIGINT) and communications intelligence (COMINT); in wartime they would support air defense and antisubmarine warfare (ASW). Breakthroughs in the Beidou/Compass satellite system (discussed later) and high-speed data links, as demonstrated by China's airborne early-warning aircraft systems, are enabling rapid Chinese UAV progress.[13] Table 1 details major dedicated, manned, aerial C4ISR platforms. Sources for details on UAVs may be found in endnote 14 below.[14]

China employs a growing variety of aircraft as dedicated ISR platforms. If developed successfully, they could give China important aerial battle-management capacity. While the role of rotary-wing aircraft is limited, fixed-wing ISR aircraft, as indicated in table 1, are numerous and diverse; hence they are covered in detail below.

To support the effective use of the PLA Air Force (PLAAF) and PLAN aviation, China is attempting to improve its airborne ISR capabilities, in part by developing several variants of airborne early-warning (空中早期, AEW) aircraft. These include two major indigenous platforms meant to build on previous efforts.

Following cancellation of Israel's Phalcon sale amid mounting American pressure in 2000, China purchased A-50 AWACS (airborne warning and control system) aircraft, a modified Ilyushin Il-76, from Russia. China has been developing the KJ-2000 indigenous AWACS-type aircraft, based on the Russian A-50 airframe, to conduct surveillance, perform long-range air patrol, and thereby coordinate naval air operations. The KJ-2000 has phased-array radar, data processing, Identification Friend-or-Foe (distinguishing friendly, hostile, and unknown tracks), C3I (command, control, communications, and intelligence systems), and data-link capability—all Chinese developed.[15] According to Carlo Kopp, "this system employs radar technology two generations ahead of that used by the US Air Force's E-3C AWACS."[16] A mid-November 2007 exercise held jointly by the South Sea Fleet and the East Sea Fleet in the South China Sea reportedly included employment of one or more KJ-2000s.[17] Four or more KJ-2000s are reportedly operational with the PLAAF's 26th Air Division.[18]

Table 1. *Selected Chinese Manned Airborne ISR Platforms*

		Type	Manufacturer	Role	Number in Service	Location	First Delivery
fixed wing	PLAAF	Y8T / Gaoxin 4	Sha'anxi Aircraft Corporation (SAC [Sha'anxi])	command post (C3I)	3	Nanjing Military Region (MR), 76th Air Regiment, 26th Air Division, Wuxi-Shuofang?	2007
		B-4052/737-300	Boeing, U.S. / Xi'an Aircraft Company Limited (XAC) modified	command post (C3I)	2		?
		KJ-2000 (A-50 Mainstay / Il-76MD)	Beriev, Russia / XAC-modified	airborne early warning and control (AEW&C)	4–5	Nanjing MR, 76th Air Regiment, 26th Air Division, Wuxi-Shuofang?	2004
		Y-8W/KJ-200	SAC (Sha'anxi)	AEW&C	4–5	Nanjing MR, 76th Air Regiment, 26th Air Division, Wuxi-Shuofang?	2007
		H-6B/HZ-6	XAC	reconnaissance/ELINT	1+	?	1979
		H-5/HZ-5	Harbin Aircraft Manufacturing Corporation (HAMC)	ISR	7	?	1966–82
		Su-30MKK Flanker	Sukhoi, Russia	reconnaissance/surveillance (SAR capability on one airframe demonstrated 2003)	73*	?	2000
		JH-7A	XAC	strike fighter / bomber (configuration variant, e.g., with BM/KZ-900 SIGINT pod)	83*	?	2004
		Y-8H	XAC	reconnaissance/surveillance	2?	?	
		Y-8CB / Gaoxin 1 Karakoram Eagle	SAC (Sha'anxi)	reconnaissance/surveillance, COMINT	6	Nanjing MR, EW Flight Regiment, 10th Air Division, Nanjing-Dajianchang?	2005–2009

Table 1. *(continued)*

	Type	Manufacturer	Role	Number in Service	Location	First Delivery
	J-8F/JZ-8FR	Shenyang Aircraft Corporation (SAC [Shenyang])	tactical reconnaissance/ surveillance	24	Shenyang MR, 3rd/4th Independent Fighter Reconnaissance Regiment, 30th Fighter Division, Shenyang Yuhuntun; and/or 78th Reconnaissance Regiment, Suzhou; and/or Jinan MR, 1st Independent Fighter Reconnaissance Regiment, 31st Fighter Division, Wendeng?	?
	J-8I/JZ-8	SAC (Shenyang)	reconnaissance/ surveillance	24		?
	J-8/JZ-6	SAC (Shenyang)	reconnaissance/ surveillance	48	Guangzhou MR, 2nd Independent Fighter Reconnaissance Regiment, 42nd Fighter Division, Taihe; and Nanjing MR, 3rd Independent Fighter Reconnaissance Regiment, 29th Fighter Division, Suzhou?	1976
	Y-8G / Gaoxin 3	SAC (Sha'anxi)	SIGINT and/or communications relay	10	Shenyang MR, 3rd/4th Independent Fighter Reconnaissance Regiment, 30th Fighter Division, Shenyang Yuhuntun; and/or Nanjing MR, 30th Air Regiment, 10th Air Division, Anqing North?	before 2011

Table 1. *(continued)*

	Type	Manufacturer	Role	Number in Service	Location	First Delivery
	Y-8EW / Gaoxin 8	SAC (Sha'anxi)	dorsal satellite communications dome + antennas; ELINT?	N/A		At China Flight Test Establishment, April 2011
	Tu-154M/D Careless	Tupolev, Russia	EW/ELINT/SIGINT	4	102nd Air Regiment, 34th Transportation Division, Beijing-Nanyuan?	1998
	HD-6	XAC	EW	1+	?	
	Y-8XZ/ECM, Gaoxin 7	SAC (Sha'anxi)	EW	2	Nanjing MR, 30th Air Regiment, 10th Air Division, Anqing North; and/or Shenyang MR, 4th Independent Electronic Warfare Regiment, Shenyang Yuhuntun; and/or Nanjing MR, 30th Electronic Warfare Regiment, 10th Bomber Division, Nanjing Dajiaocang?	2007
PLAN	Y-8J/W/WH, KJ-200, Gaoxin 5	SAC (Sha'anxi)	AEW&C	4–6	North Sea Fleet (NSF), 1st Independent Air Regiment, 5th Fighter Aviation Division, Liaoyang?	1998
	H-5/HZ-5 (Il-28 Beagle)	HAMC	ISR	7–24	NSF, 5th Bomber Aviation Regiment, 2nd Bomber Aviation Division?	1966–82
	JH-7A	XAC	strike fighter / bomber (configuration variant, e.g., with BM/KZ-900 SIGINT pod)	75*	?	2004

Table 1. *(continued)*

		Type	Manufacturer	Role	Number in Service	Location	First Delivery
		JH-7	XAC	strike fighter / bomber (configuration variant, e.g., with BM/KZ-900 SIGINT pod)	50–65*	?	1998
		Y-8JB/DZ, Gaoxin 2	SAC (Sha'anxi)	SIGINT, reconnaissance/ surveillance, and/or ELINT	5	NSF, 1st/3rd Independent Air Regiment, 5th Fighter Aviation Division, Liaoyang; 1 in South Sea Fleet, 7th Independent Air Regiment, Sanya/ Yaxian?	2004
		Sh-5	HAMC	maritime patrol / surveillance	4	NSF, 3rd Independent Air Regiment, 5th Fighter Aviation Division, Tuandao?	1986
		Y-8X	SAC (Sha'anxi)	maritime patrol / ASW	5	NSF, 1st Independent Air Regiment, 5th Fighter Aviation Division, Liaoyang?	1985
		Y-8Q / Gaoxin 6	SAC (Sha'anxi)	ASW	1–5	NSF, 1st Independent Air Regiment, 5th Fighter Aviation Division, Liaoyang?	
rotary wing	PLAN	Ka-31B	Kamov, Russia	AEW	8	?	?
		Zhi (Z)-8YJ/SA-321 Super Frelon	Changhe Aircraft Industries Group; French technology, license production	AEW	2	?	?

Notes:
Question marks indicate information not available in reliable open sources.

Owing to the profusion of constantly evolving Y-8/Gaoxin variants—many of which overlap in function—as well as extreme difficulty in determining where a given aircraft is deployed at a given time, data in this table must be interpreted with particular caution.

* Many of these may not be ISR-focused/equipped.

Sources: "Chinese SIGnals INTelligence (SIGINT) Air Vehicles," Command Information Systems, China, *IHS Jane's,* 23 December 2013, www.janes.com; Institute for International Strategic Studies, *The Military Balance 2013* (London: Routledge, 2013), pp. 286–95; "China: Air Force," *Jane's World Air Forces,* 4 June 2013, www.janes.com/; "Air Force, China," *Jane's Sentinel Security Assessment: China and Northeast Asia,* 17 September 2013, www.janes.com/; "World Navies: China," *Jane's World Navies,* 4 October 2013, www.janes.com/; "XAC KJ-2000," *Jane's All the World's Aircraft,* 8 July 2013, www.janes.com/; "SAC Y-8 (Special Mission Versions)," *Jane's All the World's Aircraft,* 7 July 2013, www.janes.com/; "XAC H-6," *Jane's All the World's Aircraft,* 8 July 2013, www.janes.com/; "Kamov Ka-31 Helix B," *Jane's Fighting Ships,* 11 February 2013, www.janes.com/; Andreas Rupprecht and Tom Cooper, *Modern Chinese Warplanes: Combat Aircraft and Units of the Chinese Air Force and Naval Aviation* (Houston, Tex.: Harpia, 2012), pp. 83–87, 110–12, 219. And see Erickson, "China's Modernization of Its Naval and Air Power Capabilities," pp. 114–15, 117, 120.

China's Y-8 medium-range transport airframe, derived from Russia's Antonov An-12 Cub transport and produced under license by the Sha'anxi Aircraft Industry (Group) Corporation, is the basis for eight Gaoxin ISR variants.[19] They perform such missions as electronic intelligence (or ELINT—variant one; and possibly an eighth variant), SIGINT (variant two), SIGINT and/or communications relay (variant three), electronic warfare / electronic countermeasures / C3I (variants four and seven), airborne early warning (variant five), and ASW (variant six).[20] Tupolev Tu-154 variants perform similar roles.

China's smaller KJ-200/Y-8 Balance Beam maritime patrol, electronic warfare, airborne-early-warning and control aircraft, with its electronically steered, active, phased-array radar (similar in appearance to, but larger than, Sweden's Ericsson Erieye active phased-array radar), complements the KJ-2000 by performing tactical AEW and ELINT more economically.[21] Various sources report that a KJ-200 aircraft crashed on 4 June 2006, killing forty people and possibly setting back the program.[22] But the program appears to be back on track, and Carlo Kopp believes that the KJ-200's technology is "two generations ahead of the mechanically steered technology used by the US."[23] On 12 March 2010, a PLAAF KJ-200 may have been spotted by the Japan Maritime Self-Defense Force near the Miyako Strait.[24] Like the KJ-2000, the KJ-200 is reported to be in service with the PLAAF's 26th Air Division;[25] the PLAN has apparently taken delivery of its first KJ-200s as well.[26]

In addition to its two dedicated AWACS platforms, and the numerous and diverse Y-8 Gaoxin variants detailed above, the PLAAF and PLAN have reconnaissance regiments with a wide range of other specialized aircraft. Relevant fixed-wing types include a number of H-6s, derivatives of Russia's Tu-16 Badger, which also conduct reconnaissance and ELINT.[27] As part of a late-2003 exercise, an Su-30MKK fighter used a new synthetic aperture radar (SAR) to surveil the length of Taiwan.[28] A portion of the PLAN and PLAAF's JH-7A strike fighter / bombers, together with the older JH-7 variant still employed by the PLAN, are apparently outfitted with BM/KZ-900 SIGINT pods.[29]

Beyond the strictly military dimension, as China strengthens its maritime law-enforcement forces and consolidates the majority of them under the State Oceanic Administration, their airborne surveillance capabilities may grow apace. On 5 March 2009, a Y-12 maritime surveillance aircraft conducted twelve fly-bys of USNS *Victorious* (T-AGOS 19), operating in international waters in the Yellow Sea, at an altitude of four hundred feet, range five hundred yards; the following day, a Y-12 conducted eleven fly-bys of USNS *Impeccable* (T-AGOS 23), operating in international waters in the South China Sea, at an altitude of six hundred feet and a range of between a hundred and three hundred feet.[30]

Space-Based ISR

Space capabilities underpin China's current naval and other military capabilities for the near seas. The successful achievement of reliable indigenous satellite navigation and high-quality real-time satellite imagery and target-locating data will greatly strengthen PLA capabilities. While still purchasing supplementary imagery, Beijing is combining foreign knowledge with increasingly robust indigenous capabilities to produce significant advances in maritime C4ISR.

China has developed a full range of military, civilian, and dual-use satellites of various mission areas and sizes. While they still face difficulties involving reliability and life span, these systems are improving rapidly.[31] China uses a variety of satellites to link sensors to shooters and to support related network functions. China's second data-relay satellite, *Tianlian-1-02/B,* provides "near real-time transfer of data to ground stations from manned space capsules or orbiting satellites";[32] *Tianlian-1-03,* launched on 25 July 2012, further extends and strengthens this capacity.[33] China's ground stations and Yuanwang-class space-event support ships add important telemetry, tracking, and command capacity. China is moving cautiously with respect to establishing overseas ground stations but plans by 2030 to have established "network nodes" at the North Pole, at the South Pole, and in Brazil as part of a "Digital Earth Scientific Platform."[34] The *Fenghuo-1* communications satellite and its identically named follow-on reportedly support military operations.[35] China has made great progress in small-satellite development; its satellites under five hundred kilograms now boast high performance, in addition to low weight. The 9.3 kg *Tiantuo-1* nano-satellite, launched on 10 May 2012, receives signals from China's shipborne Automatic Identification System.[36] The Shijian series of experimental satellites is testing new technologies. Satellite surveying and mapping are being exploited by a variety of services, including the PLAN. One South Sea Fleet unit developed a reportedly combat-relevant "Stipulated Technical Procedure for Maritime Terrain Digitized Satellite Surveying and Mapping."[37]

Maritime Surveillance Satellites

China's reconnaissance-capable satellites include electro-optical (EO), multi- and hyperspectral, and radar, especially SAR. Maritime-relevant variants include Fengyun (FY), the China-Brazil Earth Resources Satellite (CBERS), Ziyuan (ZY), the Disaster Monitoring Constellation (DMC), Haiyang (HY), Huanjing (HJ), and Yaogan (YG) satellites. Chinese sources categorize the Shenzhou (SZ) manned spacecraft, which remain as orbital modules after their crews return to earth, and the *Tiangong* (TG) space-station module launched in 2011, as relevant to reconnaissance.[38] Fengyun weather satellites provide visible, IR, and microwave imaging. Possible future launches include FY-2G and -2H in 2014, FY-3D/PM1 and FY-4 M in 2015, FY-3E/AM1 in 2017, FY-3F/PM2 in 2019, FY-3G/AM3 in 2021, FY-3H/PM3 in 2023, and FY-4 O at an unspecified date. FY-2H and FY-4 O and M will be geostationary; all others have polar orbits. Three satellite series are particularly relevant to maritime monitoring. The CBERS polar near-real-time electro-optical satellites, with 2.7-meter resolution, are used for military observation. CBERS-3 and -4 follow-ons, with resolution halved to ten meters through PAN-MUX optical sensors, may be launched as early as 2013. Yaogan satellites are already so numerous that they must be addressed separately (in the next section).

Ocean surveillance, a significant focus of Chinese satellite development, has been prioritized at the national level as one of eight pillars of the 863 State High-Technology Development Plan.[39] China launched its first three Haiyang polar maritime observation satellites in 2002 (no longer operational), 2007, and 2011. Roughly a dozen further Haiyang ocean-monitoring satellites are planned, in three sets over the next decade, with HY-1E/F possibly set for launch at this writing in 2013, HY-2C in 2015, HY-1G/H in 2016, HY-3B in 2017, HY-2D in 2018, and HY-1C/D, HY-2B, and HY-3A at unspecified dates.[40] Initial follow-ons will have three-meter resolution. China's Huanjing visible-, IR-, multispectral-, and SAR-imaging constellation is designed, once eight additional satellites join the three already in polar orbits beginning in 2013 or later, to form a complete image of China every twelve hours.[41] Table 2 surveys maritime-relevant remote-sensing satellites currently in orbit.

High-Resolution Reconnaissance, Possible ELINT Satellites: Yaogan

China's Yaogan series of twenty-three advanced, paired SAR and EO remote-sensing satellites, operating in near-polar, sun-synchronous orbits, "may provide multiwavelength, overlapping, continuous medium resolution, global imagery of military targets."[42] The series was reportedly "implemented" (实施) by China National Space Administration, though this nominally civilian organization lacks the institutional autonomy of the U.S. National Aeronautics and Space Administration.[43] With its high-resolution (five-meter) L-band SAR, *Yaogan-1* was China's first synthetic-aperture-radar satellite. SAR Yaogans are optimized for monitoring "ocean dynamics, sea surface characteristics, and coastal zones" (海洋动力, 海表特征, 海岸带), as well as "observing sea-surface targets and shallow-water bathymetry" (海面目标, 浅海地形等观测).[44] EO Yaogans, which appear to be based on the China Academy of Space Technology (CAST)–2000 small-satellite "bus" (that is, standardized "backbone" platform on which the satellite is built), monitor land and sea areas, including "coastal zones" (海岸带), with resolution as fine as a half-meter.[45] Sometimes using orbit maneuver capability, Yaogans have attained a variety of orbits, some lower than five hundred kilometers to increase resolution.[46] A major Chinese study on the nation's remote-sensing satellites states that Yaogan satellites are "very

Table 2. *China's Currently Operational Earth Observation Satellites*

Satellite	NORAD ID	International Code	Contractor	Launch Date/ Time (UTC)	Launch Site
FY-2D	29640	2006-053A	Shanghai Institute of Satellite Engineering, Shanghai Academy of Spaceflight Technology (SAST)	2006.02.18 16:53:00	Xichang
FY-2E	33463	2008-066A	SAST	2008.12.23 00:54:00	Xichang
FY-2F	38049	2012-002A	SAST	2012.01.13 00:56	Xichang
FY-3A/ AM	32958	2008-026A	SAST	2008.05.27 03:02	Taiyuan
FY-3B/PM	37214	2010-059A	SAST	2010.11.04 18:37:00	Taiyuan
CBERS-2	28057	2003-049A	CAST	2003.10.21 00:00:00	Taiyuan
CBERS-2B	32062	2007-042A	CAST	2007.09.19 03:26:00	Taiyuan
ZY-2B	?	?	?	2002.10.27	Taiyuan?
ZY-2C	28470	2004-044A	?	2004.11.06 03:10:00	Taiyuan
ZY-3	?	?	?	2012.01.09 03:17:00	Taiyuan
DMC/ BJ1/ *Tsinghua*	28890	2005-043A	?	2005.10.27 06:52:00	Plesetsk (Russia)
HY-1B	31113	2007-010A	?	2007.04.11 03:27	Taiyuan

Launch Vehicle	Orbit; Perigee × Apogee (km); Inclination (°); Period (min.); Semimajor Axis (km)[a]	Mass (kg)	Primary Sensors	Resolution (m)	Ocean Applications
CZ-3A	geostationary; 35,784.7 × 35,805.4; 1.6°; 1,436.2; 42,166	1,380	VISSR-2	?	sea temperature, color, meteorology; images every 30 min.
CZ-3A	geostationary; 35,784.7 × 35,807.4; 1.2°; 1,436.2; 42,167	1,390	VISSR-2; visible and infrared high-resolution cloud imagery	?	sea temperature, meteorology; images every 15 min.
CZ-3A	geostationary; 35,774.1 × 35,806.5; 1.3°; 1,435.9; 42,161	1,369.0	Stretched Visible and Infrared Spin Scan Radiometer	?	sea temperature, meteorology; images every 15 min.
CZ-4C	polar; 828.1 × 841.2; 98.6°; 101.5; 7,205	2,295	MERSI ocean color, VIRR IR sensors; MWRI microwave radiometer	?	sea color, temperature, wind speed, coastal zones, meteorology
CZ-4C	polar; 833.2 × 836.2; 98.8°; 101.5; 7,205	2,299	VIRR, MERSI, MWRI; 11 instruments capable of global, all-weather, multispectral, 3-dimensional, quantitative Earth observations	?	sea color, temperature, wind speed, coastal zones, meteorology
CZ-4B	polar; 781.4 × 782.6; 98.2°; 100.3; 7,152	1,600	CCD, infrared multispectral scanner (IRMSS), WFI	20	coastal zones
CZ-4B	polar; 746.6 × 791.5; 98.3°; 100.1; 7,140	1,500	CCD, WFI, HR	20 (CCD), 2 (HR)	coastal zones
?	polar	?	HR, PAN-MS	2 (HR), 5 (PAN-MS)	land, coastal zones
CZ-4B	polar	?	HR, PAN-MS	2 (HR), 5 (PAN-MS)	coastal zones
?	polar	2,630	HR, PAN-MS, CC DX2; 3 high-resolution panchromatic cameras, IRMSS	2 cameras (front/rear-facing): 3.5 m (spectral). Ground-facing camera: 2.1 m (spectral). IRMSS: 6.0 m (spectral).	coastal zones, high-resolution remote sensing, stereo mapping
Cosmos (Russian)	polar	?	PAN-MS	32/4	coastal zones
CZ-2C	polar; 787.4 × 811.2; 98.4°; 100.7; 7,170	?	COCTS, CZI; ocean color, IR, temperature sensors	?	sea color, sea temperature, coastal zones

Table 2. *(continued)*

Satellite	NORAD ID	International Code	Contractor	Launch Date/ Time (UTC)	Launch Site
HY-2A	37781	2011-043A	?	2011.08.15	?
HJ-1A	33320	2008-041A	?	2008.09.06 03:25:00	Taiyuan
HJ-1B	?	?	?	2008.09.06 03:25:00	Taiyuan
HJ-1C	38997	2012-064A	?	2012.11.18 22:53:00	Taiyuan
SZ-1	25956	1999-061A	?	1999.11.19 22:30:00	Jiuquan
SZ-2	26664	2001-001A	?	2001.01.09 01:00:00	Jiuquan
SZ-3	27397	2002-014A	?	2002.03.25 14:00:00	Jiuquan
SZ-4	27630	2002-061A	?	2002.12.29 16:40:00	Jiuquan
SZ-5	28043	2003-045A	?	2003.10.15 01:00:00	Jiuquan
SZ-6	28879	2005-040A	?	2005.10.12 01:00:00	Jiuquan
SZ-7	33386	2008-047A	?	2008.09.25 13:10:00	Jiuquan
SZ-8	37859	2011-063A	?	2011.10.31 21:58:00	Jiuquan
SZ-9	38461	2012-032A	?	2012.06.16 10:37:00	Jiuquan
SZ-10	39179	2013-029A 2013-029H (orbital module)	?	2013.06.11 09:38:00	Jiuquan

Launch Vehicle	Orbit; Perigee × Apogee (km); Inclination (°); Period (min.); Semimajor Axis (km)[a]	Mass (kg)	Primary Sensors	Resolution (m)	Ocean Applications
?	polar; 973.3 × 973.7; 99.4°; 104.4; 7,344	?	microwave radiometer, altimeter, scatterometer	?	ocean surveillance: sea surface winds, wave height, and water temperatures
CZ-2C	polar; 632.8 × 672.9; 97.8°; 97.6; 7,023	?	CCD; optical, infrared cameras; SAR; hyperspectral imager	30	sea color, red tide, vegetation, oil spills, coastal zones, sea temperature
CZ-2C	polar	?	CCD; optical, infrared cameras; SAR	30	sea color, coastal zones, sea temperature
CZ-2C	polar	890	?	?	1st radar satellite in China's environment & disaster monitor constellation, operating w/ *HJ-1A/1B* optical satellites
CZ-2F	195 × 315; 89.6; 42.6°; 0.00905	7,600.0	?	?	?
CZ-2F	330 × 346; 91.3; 42.6°; 0.00119	?	?	?	orbital module conducted zero-gravity experiments
CZ-2F	332 × 337; 91.2; 42.4°; 0.00037	?	?	?	orbital module
CZ-2F	196 × 329; 89.8; 42.4°; 0.01001	?	?	?	?
CZ-2F	?	?	?	?	?
CZ-2F	342 × 350; 91.46; 42.4°; 0.00059	?	?	?	orbital module conducted scientific research
CZ-2F	329 × 336; 91.2; 42.4°; 0	?	?	?	?
CZ-2F	?	8,080.0	?	?	?
CZ-2F	?	?	?	?	?
CZ-2F	?	7,800.0	?	?	left orbital module

Table 2. *(continued)*

Satellite	NORAD ID	International Code	Contractor	Launch Date/ Time (UTC)	Launch Site
TG-1	37820	2011-053A	?	2011.09.29 13:16:00	Jiuquan

useful for monitoring dynamics of the ocean environment and maritime monitoring" (对于海洋动力环境和海洋监视监测十分有用).[47]

Yaogan-9; *Yaogan-16A, B,* and *C;* and *Yaogan-17A, B,* and *C* constellations may constitute a vital part of a larger long-range ship-tracking and targeting ISR network. Flying in triangular formation in similar orbits at identical inclinations, each constellation apparently contains

> an electro-optical surveillance satellite, a Synthetic Aperture Radar (SAR) satellite, and possibly an electronic/signal intelligence satellite. Designed for location and tracking of foreign warships, the satellites collect optical and radio electronic signatures of naval vessels that are used in conjunction with other information by the Chinese Navy. . . . They are thought to be able to find and track large Western warships, providing accurate positioning data for targeting by land-based antiship ballistic missile systems.[48]

This is similar to the first and second generations of the U.S. Navy's WHITE CLOUD Naval Ocean Surveillance System, which reportedly detected surface vessels by sensing their electronic emissions, identifying them on the basis of their operating frequencies and transmission patterns, and locating them using triangulation and time distance of arrival.[49] In a trio of Yaogan satellites, then, one satellite would monitor a wide expanse of ocean but could not locate emitting ships precisely; two satellites together would locate emitting ships, albeit still imperfectly; and the inputs of a third satellite would locate emitting ships precisely. The ships' locations would then be transmitted to the relevant parts of the PLA reconnaissance-strike complex.[50] The Yaogan-9 system has apparently been superseded by the -16 and -17 systems, as *Yaogan-9B* has apparently fragmented into two pieces.[51] See table 3.

China possesses dedicated ELINT and SIGINT satellites.[52] China reportedly launched an ELINT satellite program, the 701 Program, in the late 1960s. Following a lengthy hiatus, during which its primary ELINT capabilities were land-based and airborne, China has redeveloped interest in dedicated satellite-based ELINT applications, and Chinese experts have conducted considerable research in this area.[53] As Mark Stokes and Ian Easton point out, China may have long launched "unidentified ELINT sensors attached to other satellite payloads, and recent launches simply represent an increase in dedicated systems."[54] China's Shijian satellites, particularly the -6 series, launched in four pairs from 2004 to 2010, are believed by some Western sources to perform SIGINT missions.[55]

Launch Vehicle	Orbit; Perigee × Apogee (km); Inclination (°); Period (min.); Semimajor Axis (km)[a]	Mass (kg)	Primary Sensors	Resolution (m)	Ocean Applications
CZ-2F	?	8,506.0	?	?	?

Notes:
Question marks indicate information not available in reliable open sources.

a. Data from "Real Time Satellite Tracking and Predictions," *ITPROSTAR,* which are typically more detailed, are used by default, except in the case of Shenzhou spacecraft, which *ITPROSTAR* does not include. For Shenzhou spacecraft, data are from "National Space Science Data Center Master Catalog," *NASA,* nssdc.gsfc.nasa.gov/. Contrary to the general column heading, orbit values from NASA for Shenzhou spacecraft are for periapsis, apoapsis, period, inclination, and eccentricity.

Sources: He Mingxia et al.,"Chinese Spaceborne Ocean Observing Systems and Onboard Sensors (1988–2025)," pp. 91–103; "Real Time Satellite Tracking and Predictions," *ITPROSTAR,* www.n2yo.com/; "National Space Science Data Center Master Catalog," *NASA,* nssdc.gsfc.nasa.gov/; "Fengyun Series," *Jane's Space Systems and Industry,* 2 July 2012.

These might include time distance of arrival and frequency distance of arrival of electronic signals received, as well as other geo-location techniques, to triangulate the position of U.S. carrier strike groups (CSGs) and other ships at sea for near-real-time tracking and targeting.[56]

Supporting PNT: Beidou/Compass Satellites

By offering reliable location signals, PNT facilitates command and control and also monitoring of friendly forces and targeting of enemy ones. The PLA regards autonomous reliability in this area as vital. A retired senior PLA official alleges that PLA analysis has concluded that unexpected Global Positioning System (GPS) disruption likely caused the PLA to lose track of the second and third missiles of a three-missile salvo fired into the East China Sea 18.5 kilometers from Taiwan's Keelung naval port in March 1996, as part of a larger effort to deter what Beijing perceived to be pro–Taiwan independence moves. "It was a great shame for the PLA . . . an unforgettable humiliation. That's how we made up our mind to develop our own global [satellite] navigation and positioning system, no matter how huge the cost. Beidou is a must for us. We learned it the hard way." Retired PLA general Xu Guangyu adds that China's Beidou and Yuanwang systems guarantee that "there is no chance now for the U.S. to use its GPS to interfere in our operations at all."[57]

Fearing that it might lose access to PNT provided by U.S. GPS and Russian GLONASS (Global Navigation Satellite System) systems in the future, and having been denied access to the military mode of Europe's nascent Galileo system, China is developing its own—Beidou/Compass (北斗卫星导航定位系统).[58] The director of the China Satellite Navigation and Locating Applications Management Center, Yang Baofeng, terms it "the

Table 3. *Yaogan Satellites Currently Operational: Notional Specifications*

Yaogan #	Military Designation	NORAD ID	International Code	Contractor	Launch Date/ Time (UTC)
2	JB-6-1	31490	2007-019A	DFH / CAST 508 Institute	2007.05.25 07:12:00
3	JB-5-2	32289	2007-055A	SAST	2007.11.11 22:48:00
4	JB-6-2	33446	2008-061A	DFH / CAST 508 Institute	2008.12.01 04:42:00
5	JB-8-1	33456	2008-064A	DFH / CAST 508 Institute / Xi'an Institute of Optics and Precision Mechanics	2008.12.15 03:22:00
6	JB-7-1	34839	2009-021A	SAST	2009.04.22 02:55:00
7	JB-6-3	36110	2009-069A	DFH / CAST 508 Institute	2009.12.09 08:42:00
8	JB-7-2?	36121	2009-072A	SAST / Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP)	2009.12.15 02:31:00
9A/B/C	?	36413, 36414/38303, 36415	2010-009A, 2010-009B/G, 2010-009C	DFH / CAST 508 Institute	2010.03.05 04:55:00
10	JB-5-3	36834	2010-038A	SAST	2010.08.09 22:49:00
11	JB-6-4	37165	2010-047A	DFH / CAST 508 Institute	2010.09.22 02:42:00
12	JB-8-2	37875	2011-066B	DFH / CAST 508 Institute / Xi'an Institute of Optics and Precision Mechanics	2011.11.09 03:21:00
13	JB-7-2	37941	2011-072A	SAST	2011.11.29 18:50:00
14	?	38257	2012-021A	CAST 508 Institute / CIOMP	2012.05.10 07:06:00
15	?	38354	2012-029A	CAST 508 Institute / CIOMP	2012.05.29 07:31:00
16A/B/C	?	39011, 39012, 39013	2012-066A, 2012-066B, 2012-066C	DFH / CAST 508 Institute	2012.11.25 04:06:00

Launch Site	Launch Vehicle	Orbit: Perigee × Apogee (km), Inclination (°), SSO Time on Descending Node	Transmission Frequency (MHz)	Mass (kg)	Type
Jiuquan	CZ-2D	631 × 655, 97.8, 13:30	2,216.527	800?	EO; HR, PAN-MS
Taiyuan	CZ-4C	627 × 629, 97.9, 06:00	2,212.809	2,700	L-band SAR
Jiuquan	CZ-2D	640 × 660, 97.9, 11:00	2,216.525	800?	EO; HR, PAN-MS
Taiyuan	CZ-4B	488 × 495, 97.4, 10:30	2,220.5	2,700	L-band SAR
Taiyuan	CZ-2C	511 × 513, 97.6, 10:00	?	2,000?	L-band SAR
Jiuquan	CZ-2D	630 × 666, 97.8, 15:00	2,216.527	800?	EO; HR, PAN-MS
Taiyuan	CZ-4C	1,200 × 1,211, 100.5, 09:30	2,266.3	1,040	L-band SAR
Jiuquan	CZ-4C	(9A) 1,089 × 1,106, 63.4; (9B) 1,060 × 1,076, 63.4; (9C) 1,089 × 1,107, 63.4	2,218 (9B)	1,000? (9A)	EO; HR, PAN-MS/ SAR/ELINT?
Taiyuan	CZ-4C	615 × 629, 97.8, 06:00	?	2,700	L-band SAR
Jiuquan	CZ-2D	627.3 × 657.4, 98.01, 09:00	2,216.527	800?	EO; HR, PAN-MS
Taiyuan	CZ-2D	488 × 498, 97.41, 10:29	?	2,700	EO
Taiyuan	CZ-2C	504 × 511, 97.11, 01:56	?	2,000?	SAR
Taiyuan	CZ-4B	472 × 479, 97.2, 14:14	?	2,700?	EO
Taiyuan	CZ-4C	1,201 × 1,206, 100.1, 14:30	?	1,040	EO
Jiuquan	CZ-4C	(16A) 1,080 × 1,089, 63.38, 106.93 min.; (16B) 1,078 × 1,090, 63.38, 106.93 min.; (16C) 1,032 × 1,081, 63.38, 106.33 min.	?	1,000? (16A)	EO/SAR/ELINT?

Note: Question marks indicate data unavailable in reliable open sources.

Sources: He Mingxia et al., "Chinese Spaceborne Ocean Observing Systems and Onboard Sensors (1988–2025)"; "Yaogan Series"; "Yaogan 9B," "Yaogan 9B DEB." Other data from "Real Time Satellite Tracking and Predictions," and "National Space Science Data Center Master Catalog"; data and format from *ITPROSTAR,* which are typically more detailed, are used by default.

largest scale, most complex, most technically demanding, and most widely applicable space-based system in Chinese aerospace history."[59] Beidou/Compass provides PNT to an accuracy of ten meters, 0.2 meters per second, and ten nanoseconds, respectively;[60] it also offers "differential" and "integrity" services.[61] Initially, unlike other PNT systems, which transmit signals directly, it transmitted signals indirectly, through a central ground station, although the PLA General Armament Department's newspaper recently reported that "after providing passive navigation and locating service, Beidou became more and more like the GPS system."[62] It also boasts a unique short-message communications system.[63] A Chinese aerospace expert contends that the system affords China numerous civil and military benefits and constitutes "an important measure to grab and retain favorable orbital position resources . . . for the purpose of 'carving up the domain before other competitors do'" [也是 "占位" 的需要].[64]

Twenty satellites have been launched thus far; sixteen remain operational. An initial two-satellite constellation was launched in 2000. Regional navigation and communications coverage, encompassing mainland China, neighboring countries (such as Pakistan, where it has been tested), and the near seas, was achieved in 2012;[65] service commenced in early 2013. Starting in 2014, a second series will be launched.[66] By 2020, a thirty-five-satellite constellation (five geostationary earth orbit, twenty-seven inclined medium earth orbit, and three inclined geostationary orbit [IGSO]) will provide global coverage.[67] IGSO satellites' high-inclination orbits improve coverage at high latitudes. Satellites launched thus far are manufactured by CAST. They weigh typically 2,300 kg at launch and 1,150 kg on station after maneuvering to initial orbit with a liquid apogee motor. They are three-axis stabilized and have twin solar arrays. The initial satellites were based on the DFH-3 bus; this changed to the -3A variant from *Beidou-G2* on and to the -3B variant from *-M3* on. All satellites have been launched from Xichang, from its Launch Complex 2 starting with *Beidou-2/Compass-M3*. See table 4.

The PLA is already using China's PNT system extensively. During long-distance exercises, Second Artillery units employ Beidou to track vehicles and communicate.[68] The North Sea Fleet headquarters information chief, Lei Xiwei, has stated that in February 2013 "Beidou provided positioning, security and protection" for the destroyer *Qingdao* and frigates *Yantai* and *Yancheng* in a South China exercise.[69]

Detecting and Tracking Maritime Targets

An emerging network of air- and space-based sensors promises to improve radically the targeting capabilities of the PLAN and other services with which it may operate, such as the Second Artillery. This critical linchpin, long limited by Beijing's lack of relevant sensor platforms, promises to give the PLA unprecedented ability to monitor surface vessels on China's maritime periphery and thereby facilitate their precise targeting with cruise

Table 4. *Beidou/Compass Satellites Currently Operational: Notional Specifications*

Satellite	NORAD ID	International Code	Launch Date/ Time (UTC)	Launch Vehicle	Orbit	Capabilities	Status
Beidou-1C	27813	2003-021A	2003.05.24 16:34:00	CZ-3A	geostationary (GEO): 110.5°E	20 m positioning accuracy	operational
Beidou-2A/ Compass-M1	31115	2007-011A	2007.04.13 20:11:00	CZ-3A	medium earth orbit (MEO) / experimental: perigee × apogee 21,519 × 21,545 km, inclination 55.3°, period 773.4 min.; by 2010.03: 21,524.7 × 21,553.5 km, 56.1°, period 773.4 min.	signal transmit carrier frequencies: 1,195.14–1,219.14 MHz, 1,256.52–1,280.52 MHz, 1,559.05–1,563.15 MHz, and 1,587.69–1,591.79 MHz; ground communications w/1 master control station, 2 upload stations, 30 monitor stations	experimental: 1st MEO satellite in series
Beidou-2C/ Compass-G1	36287	2010-001A	2010.01.16 16:12:00	CZ-3C	GEO: 140°E; initial transfer orbit: perigee × apogee 196 × 35,620 km, inclination 20.5°	?	operational
Beidou-2D/ Compass-G3	36590	2010-024A	2010.06.02 15:53:00	CZ-3C	GEO: 83.8°E; initial transfer orbit: perigee × apogee 205 × 35,647 km, inclination 20.5°	?	operational
Beidou-2/ Compass-IGSO-1	36828	2010-036A	2010.07.31 21:30:00	CZ-3A	geosynchronous (GSO): perigee × apogee 35,674.5 × 35,901.5 km, inclination 55.1°, period 1,435.8 min.; mean longitude of subsatellite ground point 118°E	?	operational
Beidou-2E/ Compass-G4	37210	2010-057A	2010.10.31 16:26:00	CZ-3C	GEO: 159.9°E	?	operational
Beidou-2/ Compass-IGSO-2	37256	2010-068A	2010.12.17 20:20:00	CZ-3A	GSO: perigee × apogee 35,714 × 35,856 km, inclination 55.24°, period 1,436 min.; mean longitude of subsatellite ground point 118°E	?	operational

Table 4. *(continued)*

Satellite	NORAD ID	Interna-tional Code	Launch Date/ Time (UTC)	Launch Vehicle	Orbit	Capabilities	Status
Beidou-2/ Compass-IGSO-3	37384	2011-013A	2011.04.09 20:47:00	CZ-3A	GSO: perigee × apogee 35,721 × 35,880 km, inclination 55.3°, period 1,435.9 min.; "figure 8" ground track centered over 118°E	completed IGSO cover-age with 3 satellites in equally spaced planes; marked establishment of basic navi-gation and positioning network	operational
Beidou-2/ Compass-IGSO-4	37763	2011-038A	2011.07.26 21:44:00	CZ-3A	GSO: perigee × apogee 35,706 × 35,878 km, inclina-tion 55.2°, period 1,436.0 min.; "fig-ure 8" ground track with intersection node over 95°E	?	operational
Beidou-2/ Compass-IGSO-5	37948	2011-073A	2011.12.01 21:07:00	CZ-3A	GSO: perigee × apogee 35,704 × 35,866 km, inclination 55.18°, period 1,436.02 min.; "figure 8" ground track	Beidou system's basic structure established; tests; trial service began 2011.12.27	operational
Beidou-2/ Compass-G5	38091	2012-008A	2012.02.24 16:12:00	CZ-3C	GEO: 58.68°E	?	operational
Beidou-2/ Compass-M3	38250	2012-018A	2012.04.29 20:50:00	CZ-3B	MEO: perigee × apogee 21,460 × 21,594 km, inclina-tion 55.16°, period 773.2 min.	?	operational
Beidou-2/ Compass-M4	38251	2012-018B	2012.04.29 20:50:00	CZ-3B	MEO: perigee × apogee 21,456 × 21,601 km, inclina-tion 55.11°, period 773.21 min.	?	operational
Beidou-2/ Compass-M5	38774	2012-050A	2012.09.18 19:50:00	CZ-3B/E	MEO: perigee × apogee 21,462 × 21,592 km, inclina-tion 55°, period 773.2 min., revs/ day: 1.9	?	operational
Beidou-2/ Compass-M6	38775	2012-050B	2012.09.18 19:50:00	CZ-3B/E	MEO: perigee × apogee 21,476 × 21,573 km, inclina-tion 55.1°, period 773.1 min., revs/ day: 1.9	?	operational
Beidou-2/ Compass-G6/G2R	38953	2012-059A	2012.10.25 15:33:00	CZ-3C	GEO: 80.1°E	completed regional net-work; service commenced	operational

Note: Question marks indicate information unavailable in reliable open sources.

Sources: "Beidou/Compass." Other data from "Real Time Satellite Tracking,"and "National Space Science Data Center Master Catalog"; data and format from *ITPROSTAR,* which are typically more detailed, are used by default.

and ballistic missiles, potentially in combination—a devastating multiaxis, saturation approach envisioned widely by Chinese analysts but requiring mobility, speed, range, and precise coordination.

To achieve its near-seas operational objectives, the PLA must thus coordinate multiple sensors and weapons among multiple services to provide comprehensive communications and a common operational picture. Satellite-based ISR will improve the ability of Chinese ballistic and cruise missiles to strike moving maritime targets. For instance, a DF-21D antiship ballistic missile might be launched on a ballistic trajectory aimed roughly at the position of a CSG, as determined partly on the basis of satellite data. Satellites might also be used to track and target the CSG—by, for instance, supplying position updates.[70]

The Beidou/Compass navigation satellite system can be used to improve the precision of Chinese ballistic missiles. China's combination of land-based radars and satellites—perhaps augmented temporarily with deployment of UAVs and launches of satellites or microsatellites—might be sufficient to track and target CSGs within a certain zone off China's coastal waters from which it is believed essential to exclude them in combat.

Examination of the orbits, inclinations, and periods of imaging satellites offers a basic sense of their coverage.[71] By 2009, China had approximately twenty-two imaging satellites with sufficient resolution to play a role in detecting and tracking a CSG.[72] This number was insufficient for continuous satellite coverage, in terms of revisit times for specific ocean areas, but since then China has added significant numbers of Yaogan satellites of multiple types, and on 26 April 2013 launched the first in a new series of Gaofen satellites.[73] In 2009, civilian experts estimated that China would launch sufficient satellites to achieve coverage regionally (eight to twelve civilian satellites, plus additional military) by 2015 and globally (a further eight to twelve civilian, plus additional military) by 2020;[74] these estimates may require adjustment, given recent launch numbers. Even before 2020, China's emphasis on small satellites and small solid-fueled rockets may allow it to achieve a satellite surge capability. China's low-cost launchers (e.g., the Kaituozhe) may offer a combination of rapid turnaround and efficiency. The development of the Wenchang Satellite Launch Center (China's fourth, scheduled to open in 2014) indicates a commitment to cutting-edge facilities.

The Challenge of Bureaucratic Coordination

Targeting enemy surface ships is a tremendously complex and difficult process. China would likely use its Qu Dian integrated C4ISR system for this purpose. Qu Dian would have to incorporate real-time sensor inputs into a multisensor data correlation and fusion process, then transmit the result to commanders and shooters. Even with complete coverage of relevant maritime zones, data transmission (i.e., from satellites to ground stations), imagery readouts by analysts (increasing in time consumption with size of area examined), and transmission of targeting data to the shooter will impose time delays. Software and data management requirements will be complex. Command and control will likely pose particular challenges: the PLA will have to coordinate both among the many service elements that "own" various ISR sensor and ground station architectures and that within the chain of command would authorize their prioritization and use, and with the release authority (CMC, supreme command, or campaign command) for the weapons systems that would employ their inputs.[75] Because of these ongoing challenges, the U.S. Department of Defense judges that "the PLA will need to overcome deficiencies in system integration and interservice coordination."[76]

Examples of related difficulties have already emerged, as well as of some progress toward surmounting them. In perhaps the best test of C4ISR and data-fusion capabilities to date, China's large-scale response to Sichuan's 12 May 2008 Wenchuan earthquake included the use of an AWACS aircraft to coordinate air traffic and of satellite imagery and ground-mapping radar and other remote-sensing aircraft, as well as a UAV, to survey damage.[77] Upon receiving these data, the National Earthquake Relief Headquarters "swiftly transmitted them to the frontline relief troops."[78] Chen Li, minister of water resources, said that "analyzing satellite and other aerial images" would allow officials to assess flooding risks stemming from "damaged reservoirs, hydropower plants, and dikes."[79] On 17 May the PLA, having reportedly detected "water rising to dangerous levels" in multiple Beichuan County lakes "using one of its most advanced satellites," ordered evacuation of the area.[80] China's massive resource deployment still left the PLA and other government organizations involved hampered in their efforts by Chinese satellite imagery that was deficient in quality and quantity, as well as by problems with data transfer, management, processing, and integration.[81]

Despite these apparently serious limitations in 2008, the PLA's response to the less-challenging 2010 Yushu earthquake seemed to reflect significant "lessons learned." For instance, the Chinese Academy of Sciences' State Key Laboratory of Remote Sensing Science used "Beijing-1 microsatellite data, with moderate spatial resolution and large sensor ground width . . . to analyze the environment background for the earthquake."[82] While China still uses imagery from foreign as well as domestic satellites, the large number of increasingly advanced satellites of many categories that China has launched since, together with its clear rationale to develop and integrate the relevant C4ISR architecture, suggests that its capabilities are now far greater. In January 2013, *China Daily* went so far as to claim that "China's first high-resolution, stereo mapping satellite Ziyuan III," launched on 9 January 2012, "meets international standards, ridding the country of its reliance on imports of satellite images."[83]

Despite this recent progress, China's ISR coordination challenge is illustrated by the present organization of its satellites as well as by the PLAAF's efforts to assume control over them. Peacetime ownership and operational control of some satellites and applications are divided among more than a dozen government, university, and civil organizations.[84] Seventy-five percent of satellites are normally run by nonmilitary organizations; wartime authority-transfer dynamics remain unclear.[85] Even granting the ability to transition smoothly to military control in wartime—a significant assumption—China's satellites and other space assets face uncertainty regarding service jurisdiction.[86] A new Space Force is rumored to be in development;[87] for now, the PLAAF appears to be best placed to assume authority over space assets.

Yet at present the PLAAF is not known to control any space assets. Indeed, the General Armaments Department (GAD), the GSD, and even the Second Artillery and the PLAN, to some extent, may be resistant to such a transfer of authority to the PLAAF, and institutional rivalry may complicate matters.[88] The GAD controls all orbital satellite operations yet lacks a combat role. The PLA already controls launch sites, the Second Artillery is heavily involved in missile programs, and various technical institutes are responsible for satellite development, so there will likely be extensive debate and negotiation within the PLA and civilian leadership concerning the ultimate control of various space assets (a process that took place earlier in the United States). Furthermore, there is not yet any clear evidence in open publications that the PLA has formally adopted space theory, doctrine, missions, or regulations, so what would govern the actions of whatever organization ultimately consolidates control is likewise unclear.

Air-breathing platforms face their own coordination challenges, given their distribution among the PLAAF, PLAN aviation, and even to some extent army aviation. Insufficient open-source information is available to determine how the PLAAF and PLAN aviation work together and divide responsibilities in various operational scenarios. As the PLAN assumes a robust deck-aviation mission, a critical question arises about the extent to which naval air assets (land- or sea-based) will receive direction from PLAAF assets like the KJ-2000. As long as the PLAN operates ski-jump carriers, it is unclear how much their air groups will contribute to the overall ISR picture, since ISR aircraft are typically underpowered relative to their weight and sophisticated versions would have difficulty launching via ski jump. This type of Chinese carrier will not be operating robust fixed-wing ISR assets like the American E-2 or S-3. Even with three carriers in the fleet, PLAN aviation would still be a primarily land-based air force. How, and to what extent, it will integrate with the PLAAF remains a key uncertainty.

Doctrine and regulations flow downward and technology upward in PLA bureaucratic processes, but there is insufficient lateral movement. Technological incompatibility remains a challenge owing to decentralized development, and software problems are even more significant than hardware problems. Institutional stovepiping remains a major barrier to integration and joint operations, neither of which has been achieved fully. The PLA's joint organizational structure is still under development and still does not penetrate effectively to lower levels. Lingering ground-force dominance is a significant impediment; the gradual rise in funding and status of the nonground forces is helping to remedy this but is proceeding only slowly. Training is not yet sufficiently joint, and there is no permanent joint training structure. The lack of a permanent joint organization at the military region level exacerbates these problems.[89] Finally, PLA commanders are tempted—and PLA theoretical writings, at least, are succumbing to the temptation—to use technology and command automation to centralize operations further. Ironically, this is precisely contrary to the goal of efforts to empower lower-level officers to make decisions in real time, a reform regarded as essential by many militaries that have actually fought "local limited wars under informatized conditions"—an experience that China lacks entirely. These factors, not the technical parameters of satellites and other sensors, will likely constitute the primary limitations on the effectiveness of Chinese ISR system employment. The place to watch for institutional innovation may be the Jinan Military Region, which is a logical "joint reform test bed," because it has all services represented, as well as a fleet headquarters, but lacks the strategic urgency of the Nanjing and Guangzhou Military Regions, which are responsible for the East China Sea (including Taiwan) and the South China Sea, respectively.[90]

Geostrategic Implications

China's air- and space-based surveillance platforms—together with their supporting infrastructure, human and otherwise—are improving rapidly but remain incomplete and are experiencing growing pains. As Larry Wortzel emphasizes, "The duration on station of its AWACS aircraft is short, their range is limited, and not all of them are capable of aerial refueling. Most of the PLA's combat ships and aircraft can engage in networked operations but can handle only a limited number of targets. In addition, not all of the weapons they carry can receive the networked combat data."[91] As a result, "neither the PLAAF, nor the rest of the PLA, can field and operate a fully digitized force that can take advantage of an integrated picture of the battlefield and apply weapons in a fully coordinated manner."[92] Improvements in these areas will bring their own problems, increasingly subjecting PLA forces to some of the very same vulnerabilities that they are targeting so efficiently in U.S., allied, and friendly militaries that might operate close to China.

Institutional wrangling for control of China's space assets continues. The sprawling, stovepiped nature of the many military services and organizations that control the satellite/C4ISR architecture further complicates the horizontal and vertical interservice, interlevel, and military-civilian bureaucratic coordination necessary for real-time data fusion to support kinetic operations. While China may be able to employ a variety of strategies to conduct centralized non-space-based C4ISR operations near its territory, it may find it difficult to attain similar results farther afield, where information assurance is more elusive.

Despite these ongoing challenges, counterintervention affords China a strategic defensive posture along interior lines and a different and considerably easier C4ISR task than that of the United States. The PLA can mitigate ongoing limitations in jointness and challenges in command and control and in target deconfliction by employing landlines, high-power line-of-sight communications, advanced planning, and geographic and temporal segregation. China's emerging C4ISR capabilities are already undergirding growing counterintervention capabilities that are in turn changing the balance of military power on the nation's maritime periphery. In the near seas, at least, China's military awareness, coordination, and targeting capabilities must already be taken seriously.

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China's Surface Fleet Trajectory

Implications for the U.S. Navy

Timothy A. Walton and Bryan McGrath

In 2011, Liu Huaqing (刘华清), the "father" of the modern Chinese navy, passed away. As the former commander of the People's Liberation Army Navy and one-time vice chairman of the Central Military Commission, Liu devised a strategy of "offshore defense" (近海防御) that not only laid the intellectual groundwork for the transformation of the People's Liberation Army Navy (PLAN) into a credible fighting force but also guided the Chinese Communist Party as it took to the sea.

Liu led the PLAN beyond China's Cold War continentalist period, advocating "blue water" capabilities beyond the "First Island Chain" (第一岛链). These capabilities were to complement the great-power status of a nation emerging from the "Century of Humiliation" and preparing for its "Century of Seapower."[1] Liu's vision of China becoming an oceanic nation is in ascendancy. For instance, the work report of the Eighteenth Party Congress (drafted by Xi Jinping, now the general secretary) called for the party to "build China into a maritime power";[2] similarly, PLAN commander Wu Shengli (吴胜利) now proclaims that "China is an 'oceanic nation.'"[3]

The PRC clearly seeks major naval power, but to what extent, and to what end? Analysis of the character and composition of China's current and future naval fleet yields insights into these important questions. This chapter examines recent developments among China's surface combatants, considers the future trajectory of China's surface fleet, and discusses implications for the U.S. Navy.

Steel in the Water

The PLAN boasts the largest force of principal combatants, submarines, and amphibious warfare ships in Asia (table).[4] Combining licitly and illicitly imported technology with indigenous development, the PLAN has rapidly narrowed technology and capability gaps between itself and other modern navies. It is now pursuing quality over quantity, while still seeking cost-effective systems.

Selected Elements of the Chinese Surface Fleet

Ship Type/Class	In Service
Destroyers	28
Type 052D	1
Type 052C	7
Type 051C	2
Type 052B	2
Type 051B	1
Type 956, 956-EM	4
Type 052	2
Type 051	9
Frigates	49
Type 054A	16
Type 054	2
Type 053 variants	31
Corvettes (Type 056)	9
Missile boats	175
Type 022	83
Other types	92
Amphibious warfare ships	56
Type 071 LPD	3
Type 072-III LST	9
Type 073-IV LSM	11
Other large & medium landing ships	33
Aircraft carriers	1
Hospital ships	6
Fleet replenishment auxiliaries	8
Mine warfare vessels	27
Submarine chasers	75

Any analysis of the trajectory of the PLAN surface fleet must consider the capabilities of its sensors and weapons and how they compare to similar U.S. Navy capabilities. This analysis will focus on six key capability areas: antiair warfare (AAW), antisurface warfare (ASUW), antisubmarine warfare (ASW), helicopter operations, carrier operations, and amphibious capabilities.

Antiair Warfare

Historically a weak area for the PLAN, the antiair warfare capabilities of the surface fleet have significantly improved over the last decade, now featuring mid- and long-range surface-to-air missiles (SAMs). This affords the PLAN a new area-air-defense (AAD) capability, allowing it to operate more confidently farther from land-based radar and air coverage and to venture into far seas. In contrast, current war-fighting concepts favor a more cautious surface campaign—using guided-missile destroyers (DDGs) as AAW pickets, for example—from within the First Island Chain, a campaign that sensibly takes advantage of China's land-based antiaccess and area denial (A2/AD) network.

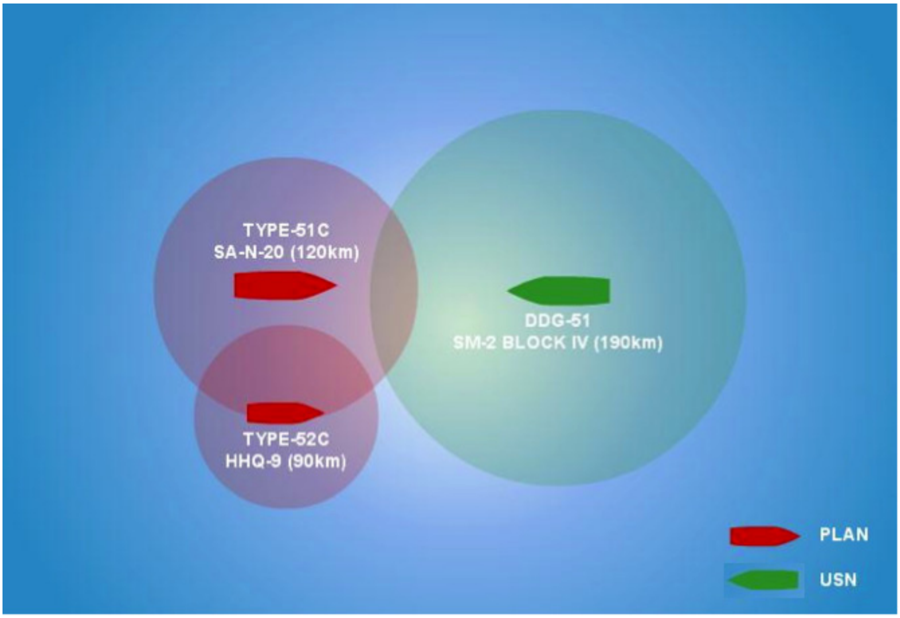
U.S. AAD capabilities, with the SM-2, SM-3, and forthcoming SM-6 weapons, generally still retain a significant edge over Chinese systems in terms of range, sensor networking, and battle management.

The PLAN has twenty-eight destroyers in active service with varying levels of AAW proficiency. The import of four *Sovremenny*-class destroyers (Type 956, 956-EM) from Russia aside, the Chinese shipbuilding industry has improved its ability to create modern and competitive naval combatants through the iterative and methodical construction of various destroyer classes. Notably, the Type 051C Luzhou DDGs integrate a phased-array radar and a vertical-launch system equipped with forty-eight Russian SA-N-20 missiles (range about 120 kilometers), the PLAN's first true area-defense SAM. The Type 052C Luyang II class features a stealthy design and an automatic detect-and-track, multidimensional, phased-array system embedded in the forward superstructure that integrates with forty-eight vertically launched HHQ-9 SAMs (approximately ninety kilometers). China's most modern major surface combatant is the new Type 052D, currently under construction. With an expected initial run of at least four ships, some observers expect eventual series production—indicating a high level of design maturity.[5]

The PLAN has forty-nine frigates and is rapidly modernizing its inventory. In 2005, the PLAN adopted the stealthy Type 054 frigate, with the limited-range, Crotale-based HHQ-7 SAM (about twelve kilometers). The Type 054A has a stealthy hull form and the HHQ-16 SAM (forty to seventy-five kilometers);[6] it is now in series production.

In addition to AAD SAMs, modern PLAN surface ships are equipped with a variety of capable terminal defenses, such as the eighteen- or twenty-four-round FL-3000-N SAM and the Type 730 30 mm close-in weapon system (CIWS). See figure 1.

Figure 1. *Selected AAD Missiles of the PLAN and U.S. Navy*
Source: Doug Richardson, ed., *Jane's Missiles and Rockets*, www.janes.com/. Graphics by Delex Systems, Inc.



Antisurface Warfare

Chinese antisurface warfare capabilities have also greatly improved over the last decade. Relative to the U.S. Navy, ASUW is likely the area where the PLAN is comparatively strongest. It has developed potent, distributed potential striking power by fielding over-the-horizon-targeting systems and outfitting its range of small and large surface combatants with advanced, longer-range supersonic and subsonic antiship cruise missiles (ASCMs) having improved electronic systems, multiaxial attack coordination, and terminal evasion maneuvers. The PLAN inventory includes the 240-kilometer-range SS-N-22, the YJ-62 (220-plus kilometers), the YJ-82 (180 kilometers), and the YJ-83 (160 kilometers).[7]

The PLAN has over eighty small surface combatants and missile craft specializing in ASUW. The Type 022 Houbei is China's newest fast attack craft. Stealthy and seaworthy, it is well suited for swarming cruise-missile attacks. Additionally, the PLAN is aggressively procuring the Type 056 class of 1,500-ton light corvettes to replace older Type 037 vessels and provide an intermediate class between the Type 022 and the Type 054A.

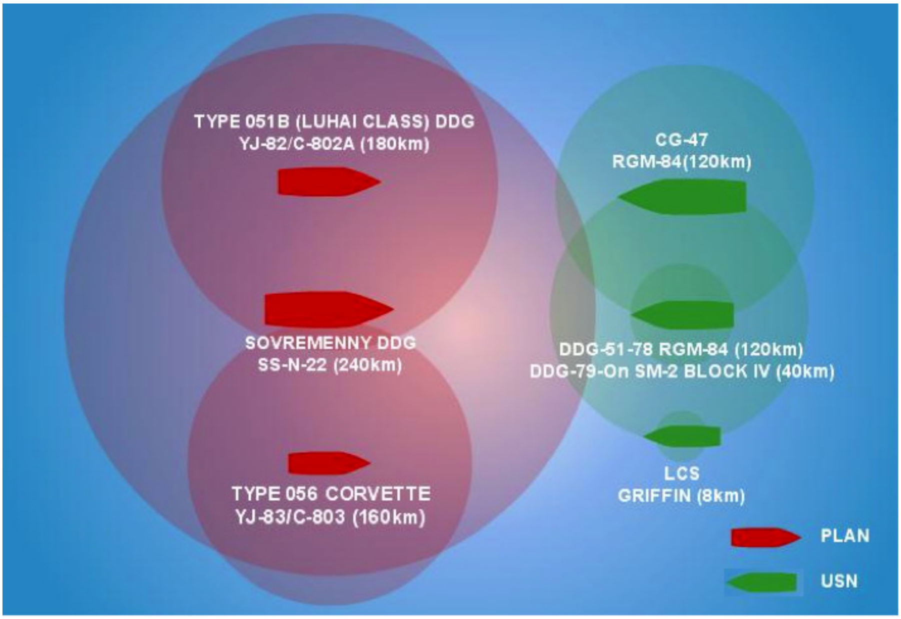
In contrast to the PLAN, the U.S. Navy has deemphasized ASCMs in its surface fleet. While some of the *Arleigh Burke*–class destroyers (hulls 51–78) and the *Ticonderoga*-class cruisers field RGM-84 Harpoon missiles, the newer DDGs (hulls 79 and later) rely on the SM-2 for inside-radar-horizon surface-to-surface missile engagements. The Littoral Combat Ship—relying as it does on warfare modules—has no ASCM native to its "seaframe," though the initial ASUW module will integrate a short-range (less than ten kilometers) missile. See figure 2.

Antisubmarine Warfare

Antisubmarine warfare has not been a core competence of the PLAN, though the Chinese have made a number of recent improvements. Additional improvement in systems, unit-level training, and coordinated operations, however, will be required if the PLAN hopes to operate with an acceptable level of risk outside the near seas. Hull-mounted medium-frequency sonar, ASW mortars, and torpedoes are commonly found among PLAN surface combatants, providing a modest antisubmarine capability highly dependent on ship operating patterns and bathymetric conditions.

In recent years, the PLAN has increased the use on its new multirole DDGs and guided-missile frigates (FFGs) of two key components of U.S. Navy surface ASW superiority: modern towed-array sonars and embarked helicopters, principally the Z-9C and the Russian Ka-28. The coordinated use of passive towed-array sonar and ASW helicopters will allow the PLAN surface fleet to utilize more effective ASW tactics in a variety of environments. Commensurately, the role of the "submarine chaser" type has diminished. For example, even the Type 056 corvette, which lacks a helicopter hangar, has a towed sonar array that offers a definite improvement over the Type 037 Hainan-class subchasers.[8]

Figure 2. *Selected SAMs of the PLAN and U.S. Navy*
Source: Richardson, ed., *Jane's Missiles and Rockets*. The SM-2 Block IV's forty-kilometer range is radar-horizon limited. Graphics by Delex Systems, Inc.



Naval Helicopters

Modern naval surface operations heavily rely on helicopters. PLAN aviation has increasingly utilized helicopters for shore-based operations and deployments aboard surface combatants. Nonetheless, the PLAN has recognized that demand for the aircraft has outpaced procurement, especially in disaster relief and in the Gulf of Aden deployments, in which the three-ship flotillas have only carried two helicopters.[9]

Demand for helicopters will continue to rise as the PLAN fields surface combatants with hangars for extended helicopter operations and as Chinese carriers take to the sea. The People's Liberation Army Naval Air Force primarily operates three helicopter types for a variety of missions: the Z-9C, the Ka-28, and the medium-lift Z-8.[10] Moreover, it has imported Ka-31s for the airborne-early-warning (AEW) mission and is funding a Z-15 project to replace the Z-9s and a "ten-ton helicopter project" to replace the Ka-28s. Of note, the Z-9C, the Ka-28, and the Ka-31, when properly equipped, may serve as a data-link relay for over-the-horizon ASCMs.[11]

The PLAN has significantly fewer helicopters than the U.S. Navy. Moreover, even Chinese proponents of increasing the number of helicopters deployed on board ships tend to focus on potential scouting and attack operations. Vertical replenishment is covered only briefly in most Chinese analyses and that on port-to-ship operations, instead of intra–task force supply.

Amphibious Capabilities

Amphibious warfare has retained an important role in the PLAN, given Chinese aspirations to incorporate Taiwan. The PLAN maintains the capability to transport approximately one mechanized division using fifty-six ships.[12] It has replaced older tank landing ships with the new Type 072-III Yuting II class and the Type 073-IV Yudeng-class medium landing ship. In active service, the PLAN also has three Type 071 Yuzhao-class amphibious transport docks, which are based on the U.S. *San Antonio* class.[13] These ships, capable of carrying large helicopters and air-cushion landing craft, may indicate a growing capability for amphibious operations in distant theaters.

Aircraft Carriers

Perhaps most representative of China's naval ambitions—and a dream of Liu Huaqing—is its aircraft carrier program. After years of deception and denials, the PLAN has publicly announced that it desires aircraft carriers. Although Chinese officials have not revealed a fleet size, one Chinese general recommended "at least three";[14] unconfirmed reporting has stated the PLAN intends to build two new carriers along the lines of *Liaoning,* the refitted ex-*Varyag,* followed by two larger and nuclear-powered carriers.[15] Operational proficiency aside, a navy of four carriers would be formidable in the region.

HQ-10 SAMs and the new Type 1030 CIWS guns have been installed on *Liaoning,* increasing the likelihood that China will consider it more than just a training ship. In terms of flight training, over the last several years China has produced a cadre of pilots to operate off carrier decks at *Liaoning* mock-ups ashore in China. Additionally, training at the NITKA Center in Ukraine and on Brazil's *Clemenceau*-class aircraft carrier has allowed the PLAN to gain experience from other nations. Regarding carrier aircraft, the PLAN has developed the carrier-capable Shenyang J-15 Flying Shark, an unlicensed variant of the Su-33.[16] There has also been speculation that China's new J-31 stealth fighter could be carrier capable.[17]

The J-15 (or other aircraft) would operate using a STOBAR (short takeoff but arrested recovery) ski-jump system on *Liaoning*. This will likely restrict its maximum takeoff weight. For this reason, future Chinese carriers may incorporate a CATOBAR (catapult-assisted takeoff but arrested recovery) system. Although the PLAN has Russian Ka-31s suitable for the AEW mission, a more-capable fixed-wing AEW project based on the Y-7 airframe, which would likely require catapult launch, may be in development.[18]

In the near term, the PLAN's aircraft carrier will support national pride more than immediate operational requirements. The PLAN will require additional DDGs, FFGs, helicopters, and logistics ships (possibly all organized under a new expeditionary command structure), not to mention a proficient carrier air wing, in order to integrate truly the striking power of the aircraft carrier into its fleet. Chinese observation of and training with the carriers of other states will accelerate this process.

From assessment of the current capabilities of the PLAN, it is clear the PLAN is rapidly developing world-class capabilities in all combat areas.[19] Compared with U.S. Navy surface combatants, PLAN surface combatants, armed with a diverse array of very capable ASCMs across the surface fleet, are more capable in ASUW. PLAN capabilities in AAW, ASW, and force integration are inferior to those of the U.S. Navy.

The Three Fleets: Possible PLAN Trajectories

In light of the PLAN's acquisition and deployment of new platforms, the United States and Asian states must consider whether the Chinese surface force has an overarching trajectory. It is widely accepted that the PLAN has demonstrably improved both its naval capabilities and its capacity to exert from the Chinese mainland control over the near seas. What remains subject to debate is the objective of these capabilities. The second half of this chapter explores this question.

The Taiwan Fleet

If the ultimate aim of China's naval development is solely to constrain the U.S. option of intervening in a mainland China / Taiwan war, such a goal appears to be increasingly within reach. Characterized increasingly in the United States as an A2/AD strategy, Chinese integration of land, sea, air, and space surveillance and strike capabilities has produced an environment in which U.S. naval forces would find themselves considerably challenged to operate meaningfully to support Taiwan under relevant timelines. This is troubling to many, including American defense planners, who are bound by the Taiwan Relations Act.

Chinese interlocutors have often supported the view that A2/AD capabilities are solely focused on the question of Taiwan and that "if the U.S. could abandon Taiwan, [China] would cease development of A2/AD capabilities, and other difficult issues could be solved."[20] However, the versatility (and thus utility) of the People's Liberation Army's A2/AD capabilities and the fact that China has other, growing security concerns besides Taiwan strongly suggest that resolution of the Taiwan issue would not remove the impetus for continued naval development.

The East Asia Fleet

If the PLAN were modernizing to establish China as the regionally dominant naval power (superior even to the United States), with control over its near seas, the PLAN would likely look much as it does today, though certain capabilities would have to be improved. The East Asia Fleet would operate mostly within the near seas but would also need a limited capability in the far seas (between the First and Second Island Chains) and for distant operations. This fleet would help deter the entry of U.S. forces into the region, enable the coercion of neighboring states, allow the establishment of faits accomplis relating to maritime territorial disputes, and generally establish China as a regional hegemon.

To realize fully such a fleet, the PLAN requires additional expeditionary surveillance to extend coverage and targeting, pushing the U.S. culmination point in battle farther from China's shores. Second, it may require expeditionary troops, such as its marine corps, to seize, hold, and man such surveillance sites on islands in dispute. Third, it requires amphibious shipping to project expeditionary power. Fourth, it requires coordinated AAW capabilities to protect itself from airborne attack. Fifth, it requires comprehensive ASW capabilities to protect its amphibious and carrier assets from submarines. Lastly, it requires additional submarines of its own to contest U.S. surface forces and aircraft carriers.

The Global Navy Fleet

Were China to seek a globally influential navy, one capable of imposing local sea control wherever it wished and capable of protecting the sea lines of communication (SLOCs) to and from its dispersed economic interests, this would be consistent with some interpretations of the final stage of Liu Huaqing's "three-step strategic plan," according to which by 2020–50 China would reach military parity with developed countries.[21]

To reach such a point, several decades of consistent effort would be needed, and a number of capabilities would have to be enhanced. First, the modest underway-replenishment logistics force of the PLAN would need to expand. There is significant indication that the Type 903 project aims to improve capabilities in this area rapidly.[22] Second, the PLAN would need to establish a network of facilities and basing arrangements astride its areas of operation. Given China's pledge never to base military forces outside China, the PLAN could seek facilities arrangements, "places, not bases." Alternatively, it could cooperate at a given location with the host country, which would claim Chinese forces were only visiting. Third, helicopter operations from surface ships for intra–task force resupply and a host of other missions—among them ASW—would need to increase greatly. Fourth, coordinated, fleet-level ASW capabilities would need to achieve a higher level of proficiency for the PLAN to operate safely in distant waters. Fifth, the PLAN would need to develop a carrier fleet, or an alternative air-asset-generating platform, that could provide constant surveillance and striking power. Lastly, the PLAN would require additional nuclear-powered attack submarines (SSNs) to threaten adversary SLOCs credibly.

What Is the Surface Fleet's Trajectory?

On the basis of assessment of the three fleet constructs and of the PLAN's current capabilities and trends, it appears that China aims to achieve a regionally dominant and globally capable navy in the next decade, a navy falling somewhere between the East Asia Fleet and the Global Fleet. The surface fleet will continue its ASUW expertise while improving its AAW and ASW capabilities, in that order. The PLAN focus will remain on potential conflicts in the near seas while it creates a limited set of capabilities useful in more distant scenarios. Faced with national development priorities in this period of "strategic opportunity," China is unlikely to assume the high cost of full transition to a globally influential, power-projection navy in the near term. Instead, it might slowly integrate carrier groups in a "hybrid" force focused on the western Pacific but capable of limited force projection. Nonetheless, if China's perception of its comprehensive national power and the favorable local correlation of forces continues to increase, Chinese naval aspirations will also gradually ascend, and the navy will shift to a more balanced, sea-control force rather than a sea-denial one.

What are some of the challenges China will face as it strives for a regionally dominant and globally capable navy? One potential factor affecting the growth trajectory of the surface fleet could be the state's shipbuilding capacity and fiscal resources. However, critical examination reveals robust capacity on both fronts. Backed by a prosperous commercial industry, China's military shipbuilding capacity and capabilities may pose a far more significant challenge in a long-term competitive dynamic than once did those of the Soviet Union. Moreover, China's moderately paced naval development has not strained the capabilities of shipyards or forced the nation to choose between expanding the navy, on one hand, and other components of the "national fleet," such as civil maritime organizations, on the other. On the contrary, the other elements of the national fleet are greatly increasing production while naval production also increases. Another possible challenge to the surface fleet's trajectory could arise if the PLAN encountered production difficulties with more advanced designs. However, the success of the Type 052C and the Type 054A suggest that China is quite capable of producing world-class surface combatants.

Strategic choices among "joint" capabilities could also shape China's shipbuilding strategy and larger maritime defense strategy. If the PLAN chose to rely on the shore-based A2/AD complex to deliver ASUW strikes over long range, it could conceivably reduce the number of surface combatants, as fewer would be necessary to meet planning needs. We assess this as unlikely, for three principal reasons. First, it is improbable that the open-ocean surveillance "scouting effectiveness" of the A2/AD complex will be reliable enough in wartime conditions to merit reducing shipboard sensors and weapons.[23] Second, institutional inertia on the part of the PLAN in connection with the current shipbuilding program would be difficult to overcome rapidly. Third, China's emerging operating patterns make a reduction in surface combatants unlikely; in fact, they may increase in number, thereby constituting a greater portion of the fleet.

The U.S. Office of Naval Intelligence anticipates that the PLAN's total order of battle will remain relatively steady, with the surface force maintaining seventy major combatants through 2020.[24] By 2016–17, as Chinese sea-denial capabilities reach a high level of effectiveness, the PLAN may gradually begin to adopt a sea-control fleet design that will likely require greater numbers of surface combatants. Additionally, such missions as extended operations in distant seas, SLOC protection, response to nontraditional threats, and possibly noncombatant evacuation operations will require larger numbers of new, large DDGs and FFGs on station, though marginal efficiencies arising from the multi-mission capabilities of modern ships may decrease the need slightly.

Analysis of the PLAN surface-fleet trajectory suggests that certain leading indicators could serve as "wild cards," factors that might put in question analytical assumptions and possibly the fleet trajectory. If China conducts a major expansion of its modest underway-replenishment program (as it may now be doing), that could point to PLAN ambitions to operate farther from China.[25] Furthermore, if the PLAN were to expand its SSN program, that might indicate an interest in conducting sea-denial or SLOC-interdiction operations at significant ranges, also putting into question its trajectory.

Implications for the U.S. Navy and East Asian Allies

The United States has adopted with China a hedging approach that seeks to maximize cooperative opportunities for engagement while maintaining credible, forward-stationed combat power in the Asia-Pacific. The interaction, both cooperative and adversarial, of the U.S. Navy and its Asian allies and partners with the PLAN has increased in the last several years, and China's neighbors have expressed reservations over the direction of its "peaceful development," specifically the trajectory of its military forces. Chinese actions—including harassment of U.S. Navy ocean-surveillance vessels, condescension toward other countries at the 2010 ASEAN Regional Forum, Beijing's response to North Korea's sinking of the South Korean corvette *Cheonan,* and serious confrontations at sea with Korean, Filipino, and Japanese maritime forces—have been the source of much anxiety in the region.

In turn, the Barack Obama administration has renewed its attention on the region, with a "rebalance to the Asia-Pacific" that dedicates increased intellectual capital and resources to efforts in the region. Hope for cooperation with the PLA springs eternal. However, American diplomatic engagement with China over the last several years has progressed and regressed as Chinese leaders interrupt military exchanges and confidence-building measures in response to such U.S. actions as arms sales to Taiwan. Additionally, the prospects remain very low for an "Incidents at Sea–style" agreement or cooperation in the distant seas tending to influence China's intentions away from revisionist efforts to counter the security architecture in the Pacific.

Faced with the likely trajectory of the Chinese surface fleet and of the PLA as a whole, the U.S. Navy must analyze how it can efficiently and effectively respond to the challenges that the United States and its Asian allies and partners will face. In a period of long-term strategic competition, the U.S. government must examine changes in force structure, posture, and operations to meet the rising challenge. Chief among these initiatives is the counter-A2/AD Air-Sea Battle Concept, which will likely result in significant improvements in U.S. force posture, strategy, and tactics in the Asia-Pacific.

In developing Air-Sea Battle, the services face the challenge of operating close to and within China's A2/AD network, confronting the perils embodied in Adm. Horatio Nelson's adage that "a ship's a fool to fight a fort." Yet allies, access, and interests may require the United States to do just that. Strategic force dispersal and increased underway refueling and reloading may significantly improve the survivability of U.S. forces. But in addition to moving some forces out, the United States must find novel ways to dig others in. It could explore subtle ways to create conditions in which U.S. forces are intermixed (in an undemanding way) with the forces of our allies, thus increasing the risk for China of horizontal escalation with multiple U.S. allies.

In terms of credibly threatening the Chinese center of gravity, an extended blockade at sea and on land, primarily targeting energy flows, has been considered as an option.[26] While an extended blockade would play a role in a major war, the latent strategic effects of such a campaign would not be felt in China for weeks or perhaps months, making it a questionable deterrent to possible Chinese moves to establish a fait accompli in the region. Moreover, such an approach might spark fears of abandonment among allied states and weaken the very security architecture the United States is working to defend.

Thus the United States must learn not only to "lay siege" to the fort but also to (in varying degrees) assault it. Fortunately, the Asia-Pacific is not a blank slate. Working to maximize cooperation with allied and partner states, the U.S. Navy could greatly inhibit the freedom of the PLAN, "penning in" the Chinese fleet. Nelson's warning applies as much to the PLAN as it does to the U.S. Navy. The undersea domain could be surveyed with overhead and underwater infrastructure—thereby turning dangerous proximity to the Chinese mainland into an advantage—and the U.S. Navy could develop ways to block straits if necessary, using mines; mobile, ground-launched ASCMs; and other methods. Moreover, as expressed in the Joint Operational Access Concept, the United States could leverage external lines of operation to conduct credible, multiaxial strikes.[27]

As for programs, the U.S. Navy could support a variety of new weapons aimed at countering the A2/AD challenge, with such platforms and capabilities as antiship missiles, ground-based offensive fires, long-range unmanned vehicles, aerial and undersea infrastructure and weapons, electronic warfare, and electromagnetic and directed-energy weapons. The U.S. Navy could also seriously explore sea-based conventional intermediate-range ballistic missiles to complicate PLA planning. Launched from ships, these weapons would count against neither the Intermediate-Range Nuclear Forces Treaty nor New START limits on submarine-launched ballistic missiles. A submarine variant would significantly alter the calculus of Chinese planners with respect to the threat of American SSNs.

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Abbreviations and Definitions

A

A2/AD	antiaccess / area denial
AAD	area air defense
AAW	antiair warfare
AESA	active electronically scanned array
AEW	airborne early warning
AIP	air-independent propulsion
AIS	Automatic Identification System
ASBM	antiship ballistic missile
ASCM	antiship cruise missile
ASUW	antisurface warfare
ASW	antisubmarine warfare
AWACS	airborne warning and control system [or the U.S. Airborne Warning and Control System, in the E-3 Sentry]

C

C3I	command, control, communications, and intelligence systems
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CAST	China Academy of Space Technology
CATOBAR	catapult-assisted takeoff but arrested recovery
CBERS	China-Brazil Earth Resources Satellite
CDCM	coastal-defense cruise missile
CEP	circular error probable
CIWS	close-in weapon system
CMC	Central Military Commission

COMINT	communications intelligence
CSG	[aircraft] carrier strike group
CSIC	China Shipbuilding Industry Corporation

D

DDG	guided-missile destroyer
DMC	Disaster Monitoring Constellation
DoD	Department of Defense [U.S.]

E

EEZ	exclusive economic zone
ELINT	electronic intelligence
EO	electro-optical
ESM	electronic support measures
EW	electronic warfare

F

FAE	fuel-air explosive
FDO	flexible deterrent option
FFG	guided-missile frigate

G

GAD	General Armaments Department
GLONASS	Global Navigation Satellite System (Globalnaya navigatsionnaya sputnikovaya sistema)
GPS	Global Positioning System
GSD	General Staff Department

H

HALE	high-altitude, long-endurance
HE	high explosive
HFSWR	high-frequency surface-wave radar

I

IGSO	inclined geostationary orbit
IRST	infrared search and track
ISR	intelligence, surveillance, and reconnaissance

K

kg/kN	kilograms per kilonewton
km	kilometers
KMT	Kuomintang [Chinese Nationalist Party]

L

LCS	Littoral Combat Ship
LO	low-observable
LRPS	long-range precision strike

M

MRBM	medium-range ballistic missile

N

nm	nautical mile

O

ONI	Office of Naval Intelligence [U.S.]
OTH	over-the-horizon
OTHR	over-the-horizon radar
OTHT	over-the-horizon targeting

P

PLA	People's Liberation Army
PLAAF	People's Liberation Army Air Force
PLAN	People's Liberation Army Navy
PLANAF	People's Liberation Army Naval Air Force
PNT	positioning, navigation, and timing
PRC	People's Republic of China

S

SAM	surface-to-air missile
SAR	synthetic aperture radar
SIGINT	signals intelligence
SLBM	submarine-launched ballistic missile
SLOC	sea line of communication
SS	diesel-electric submarine
SSB	ballistic-missile submarine

	SSBN	nuclear-powered ballistic-missile submarine
	SSN	nuclear-powered attack submarine
	STOBAR	short takeoff but arrested recovery
	SWATH	Small Waterplane Area Twin Hull
T	**T-AGOS**	tactical auxiliary general ocean surveillance ship
	TEL	transporter-erector-launcher
U	**UAV**	unmanned aerial vehicle
	USN	U.S. Navy
V	**VHF**	very high frequency
	VLF	very low frequency
W	**w/t**	weight-to-thrust

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